U. S. DEPARTMENT OF AGRICULTURE,

BUREAU OF SOILS—MILTON WHITNEY, Chief.

IN COOPERATION WITH THE STATE COLLEGE OF AGRICULTURE AT CORNELL UNIVERSITY, L. H. BAILEY, DIRECTOR; E. O. FIPPIN, IN CHARGE OF SOIL SURVEY.

SOIL SURVEY OF DUTCHESS COUNTY, NEW YORK.

BY

CHARLES N. MOONEY AND H. L. BELDEN.

[Advance Sheets—Field Operations of the Bureau of Soils, 1907.]

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

[PUBLIC RESOLUTION—No. 9.]

JOINT RESOLUTION Amending public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, "providing for the printing annually of the report on field operations of the Division of Soils, Department of Agriculture."

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That public resolution numbered eight, Fifty-sixth Congress, second session, approved February twenty-third, nineteen hundred and one, be amended by striking out all after the resolving clause and inserting in lieu thereof the following:

That there shall be printed ten thousand five hundred copies of the report on field operations of the Division of Soils, Department of Agriculture, of which one thousand five hundred copies shall be for the use of the Senate, three thousand copies for the use of the House of Representatives, and six thousand copies for the use of the Department of Agriculture: *Provided*, That in addition to the number of copies above provided for there shall be printed, as soon as the manuscript can be prepared, with the necessary maps and illustrations to accompany it, a report on each area surveyed, in the form of advance sheets, bound in paper covers, of which five hundred copies shall be for the use of each Senator from the State, two thousand copies for the use of each Representative for the Congressional district or districts in which the survey is made, and one thousand copies for the use of the Department of Agriculture.

Approved, March 14, 1904.

[On July 1, 1901, the Division of Soils was reorganized as the Bureau of Soils.]

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
BUREAU OF SOILS,
Washington, D. C., August 13, 1908.

SIR: The accompanying manuscript and map cover the soil survey of Dutchess County, N. Y., one of the projects included in the field season of 1907.

This work was undertaken in cooperation with Cornell University, Dutchess County having been suggested as a suitable project because of its agricultural importance, varied soil conditions, and its position in an unsurveyed part of the State. In the selection of this area the Bureau was aided by the officials of the Cornell Agricultural Experiment Station.

I hereby recommend the publication of the report and map covering this survey as advance sheets of the Field Operations of the Bureau of Soils for 1907, as authorized by law.

Very respectfully,

MILTON WHITNEY,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

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Soil map, Dutchess County sheet, New York.

SOIL SURVEY OF DUTCHESS COUNTY, NEW YORK.

By CHARLES N. MOONEY and H. L. BELDEN.

DESCRIPTION OF THE AREA.

Dutchess County is situated in the southeastern part of the State of New York, between the Hudson River and the State of Connecticut and midway between New York City and Albany. The Hudson River forms the western boundary of the county, the distance being approximately 45 miles, while along the Connecticut State line the distance is somewhat less. On the south the county is bounded by

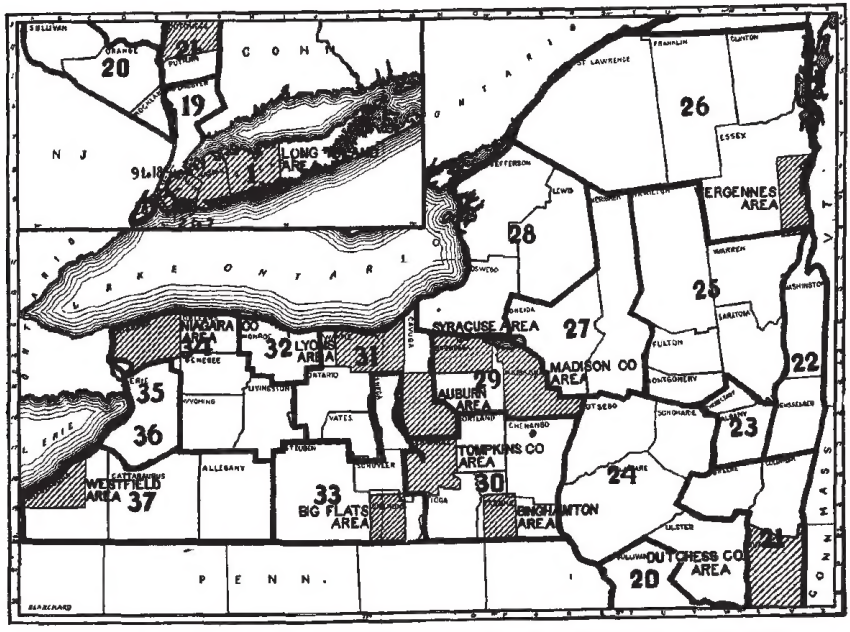

FIG. 1.—Sketch map showing location of the Dutchess County area, New York.

Putman County; on the east by Fairfield and Litchfield counties, Conn.; on the north by Columbia County, and for less than a mile in the extreme northeast by Berkshire County, Mass. It is included between the parallels of 42° 27′ and 42° 5′ north latitude, and meridian 74° west from Greenwich passes about a mile west of the most western point in the county.

The county comprises 511,872 acres or approximately 800 square miles. Politically it is divided into 20 towns (townships) with a total population of 81,670, as reported by the census of 1900.

Dutchess County possesses an uneven or diversified surface. It has no very extensive level or undulating areas, but hills and ridges of varying elevations are common, some of them over 1,000 feet in height, more or less rugged and mountainous, and cut by a number of troughlike valleys, the general relief being the work of preglacial erosion. The topography was modified to some extent during the Glacial epoch, as this section was glaciated, though feebly, and the result is shown in some parts of the county, where the surface is characteristically glacial, in that the hills, ridges, and even the mountains are more or less rounded or smooth in contour.

The elevations within the county range from sea level on the Hudson River, which here has a tidal flow, to a little over 2,300 feet on the highest mountain in the extreme northeast corner of the county.

From the Hudson River, which really occupies a gorge in the valley itself, the banks rise rather abruptly for the most part—in some places being sheer rocky precipices of 100 feet—to a terrace at its highest parts about 200 feet above the level of the river. This terrace is eroded to some extent and marked by rocky or stony knolls and ridges ranging from 25 to 300 feet high. It forms a belt of varying width along the whole extent of the river in the county, being broadest in the town of Red Hook, where it is 4 or 5 miles wide, and tapering to a point in the extreme southern part of the county. To the east of this terrace the hills or ridges rise 100 feet or more, increasing to a mean elevation of 500 feet, with occasional higher hills. From the towns of La Grange, Pleasant Valley, and Hyde Park a broad belt of rough, broken country, with occasional well-rounded hills, extends north through the central part of the county to the county line and beyond. East of this belt, in an area extending diagonally across the county from northeast to southwest, glaciation is marked, the hills being smoothed and rounded and often of drumlinoid shape. In the southeastern part of the county the hills rise about 300 feet above sea level, but gradually increase in elevation to 1,200 feet or more to the north and east, at the same time becoming broader and dome-shaped, with long, smooth slopes.

The mountainous part of the county lies along the southern and eastern boundaries. The Fishkill Mountains, which are a part of the Hudson Highlands, begin at the extreme southwest corner of the county. Breakneck Ridge rises abruptly at this point from the Hudson River as a bold promontory and extends south from the river to its highest point on South Beacon, 1,635 feet above the Hudson or sea level. The mountains on their southern sides break into precipitous cliffs or steep, rocky talus slopes, while the northern slopes are com-

paratively smooth, though steep. These mountains continue along the southern boundary of the county to the town of Pawling, but become less rugged and are continued or replaced to the northward by a high, broad ridge, known in part as Chestnut Ridge, the eastern side being steep and in places almost precipitous, forming the western wall or slope of the Pawling-Dover Valley. North of Tenmile River, in the town of Dover, the mountainous topography follows the eastern side of the Dover Valley, continuing along the Connecticut State line, with some interruptions, as rugged mountainous ridges, culminating in Brace or Monument Mountain, the highest point, at an elevation slightly over 2,300 feet, and on into the State of Massachusetts, where there are still higher points. South of Tenmile River and along the State line the topography consists of a high, broad, rolling, smoothed, glaciated ridge more than 1,000 feet in elevation, locally known as Quaker Hill.

There are three main interior valleys in the county, named from the streams which occupy them. The trend of these valleys is from the northeast to the southwest. These are the Wappinger Valley, which extends entirely through the county from Pine Plains in the northern boundary to New Hamburg on the Hudson; the valley of Fishkill Creek in the towns of Fishkill and East Fishkill, which divides near Hopewell Junction into two forks known as the Clove Valleys, the most extensive valley area in the county, the stream draining the central and southern parts of the county; and finally the well-defined valley extending the whole length of the county parallel to the eastern boundary and only a few miles distant, occupied by Tenmile River and its tributaries, Swamp River and Webatuck Creek, which join it from the south and north, respectively. This valley is really a continuation of the Croton Valley from the south and is locally known in the town of Pawling as Pawling Valley and in Dover as the Dover Valley. These valleys are pre-Glacial and have been formed by the relatively more rapid weathering of their rocky floors, which are composed largely of such soluble rocks as limestone and dolomite. All these valleys are characterized by flat gravelly terraces, contiguous to the stream courses, for the most part continuous but irregularly shaped and marked by smooth, drumlinoid-shaped hills, the work of glaciation, and by long, narrow ridges, feebly glaciated, with frequent outcropping ledges. The pre-Glacial valleys have been partially filled and the drainage channels obstructed by depositions of glacial debris, whereby ponds and small lakes or swampy and meadow areas have been formed. Some sections, however, hardly show glaciation at all, the ice having scoured off the surface and left little or no glacial debris. Since that time these localities have been subjected to the agencies of weathering and erosion. These areas are in contrast with those

smoothed by the ice and covered by a mantle of glacial till, being marked by a rough topography and frequent irregular rock outcrop.

Poughkeepsie, the county seat, on the Hudson, midway between the northern and southern boundaries, is the largest city, having a population of about 25,000 at the last census. It has important manufactures and is a railroad center and shipping point for the river traffic. It is also the site of Vassar College. Fifteen miles south of Poughkeepsie, on the Hudson River, are Fishkill-on-the-Hudson and Matteawan, practically a single place, with a combined population of over 10,000 and second in importance both in population and in manufacturing. The power for all factories is obtained from Fishkill Creek. Wappingers Falls is another important manufacturing town. It has an important water power in Wappinger Creek. There are numerous other villages scattered over this county, some of them noted chiefly for their summer residences of wealthy city people. The towns of over 1,000 population are Rhinebeck, Millbrook, and Tivoli. The most important towns of less than 1,000 population are Fishkill village, Hyde Park, Staatsburg, Rhinecliff, Red Hook, Pine Plains, Pawling, Dover Plains, Amenia, and Millerton, the last being a railroad center in the northeastern part of the county.

The drainage of the county is mostly effected by a number of important creeks with numerous tributaries, the general direction of flow of the main streams being to the southwest into the Hudson River. The larger creeks are Fishkill, Wappinger, Fallkill, Crum Elbow, Landsman Kill, and Stony. Roaloff Jensen's Kill drains a part of the towns of Milan and Pine Plains, barely entering the county itself and flowing northwesterly through Columbia County to the Hudson. On the east the drainage is into Tenmile River, and then into the Housatonic River in Connecticut. On the south the main tributary is Swamp River, on the north Webatuck Creek. All these streams are swift, flowing over rocky floors, with numerous rapids and occasional falls.

There are numbers of ponds and lakes in the county which are the sources of the larger streams. They are without exception due to obstruction of drainage by glacial action or by artificial damming. The principal ones are Whaley and Stissing ponds and Sylvan Lake.

The county has exceptionally good transportation facilities both by rail and by water. Railroads touch nearly all points in the county or at convenient points in adjoining counties, so that no section is far distant from a railroad station. Two divisions of the New York Central Railroad traverse the county from north to south; the Hudson River Division in the western part follows the bank of the Hudson River and the Harlem Division passes through the valley in the eastern part of the county. On the opposite bank of the

Hudson River the West Shore Railroad, to which connections are had by ferry from Fishkill, Poughkeepsie, and other points, also affords some service to the county.

From east to west the Central New England Railway and the Hopewell branch of the New York, New Haven and Hartford afford connections from interior points with the main lines of the New York Central Railroad, particularly at Brewster and Millerton. Electric lines connect Poughkeepsie, Wappingers Falls, and Fishkill Landing with Fishkill village.

The bulk of the freight, both through and local, is carried by water by the numerous steamboat lines on the Hudson River, at rates cheaper than those of the railroads, and the service is very satisfactory. Numerous highways reach the various shipping points and are kept in excellent condition.

Farm products meet with ready sale in the manufacturing and residential towns of this and neighboring counties, but New York City is the principal market. Dairy products, particularly milk, are shipped to New York City or its vicinity. Fruits are also sent to these markets, but fancy apples bring better prices abroad, particularly in England, and large quantities are exported. Violets, the growing of which is a specialty in a certain part of the county, find a market in New York City and other cities in the State, in New England, and even as far west as Chicago, the latter city being considered an especially good market.

The settlement of Dutchess County began about two and a quarter centuries ago, at about the same time as, or a little later than, the neighboring counties as at present organized. The settlement of Dutchess County was begun and developed in two separate sections by people of different nationalities. The earliest settlement was made by the Dutch from New York and Albany in the section along the Hudson River, while the valley in the eastern part of the county contiguous to Connecticut was settled by pioneers of English descent from New England. The first authentic settlement in the county was at what is now Fishkill village, in 1682, and was followed a few years later by settlement at Poughkeepsie and Rhinebeck.

The eastern part of the county was not settled to any extent until fully a half century later than the section along the Hudson, although there had been an occasional settler early in the century. About 1741 a number of English Quakers from Rhode Island and Long Island settled in the eastern part of the county and it is said they became quite numerous by 1755. Their descendants now form a considerable part of the population of that section. Pioneers from Connecticut and other New England colonies also became settlers in this county.

The development of the county was slow, the chief difficulty being the manner in which land was held, which was upon leaseholds. In 1683 the county had been organized, but for administrative purposes was provisionally attached to Ulster County until 1713. By 1714 the county population amounted only to 445, of whom 29 were negro slaves. The second half-century after settlement marked great increase in population, for by the time of the Revolution it had reached about one-fourth of what it is now and was extending to all parts.

The whole county is now settled, though in the rougher parts rather sparsely. According to the last census (1900) Dutchess County has a population of 81,670. Nearly one-third of this is in Poughkeepsie, while of the remainder, something over one-half is in the towns, so that the urban population exceeds the rural.

The present population is not only composed of descendants of the early settlers, who represent a large proportion of the population, but in addition there are, aside from laborers in manufacturing industries, many new residents, among them, of course, farmers and farm laborers. City business people are also buying farms and estates and living upon them the whole or part of each year. Foreigners are also represented, but many of these are transient. They are principally Italians, who labor on the public works as well as on farms and estates. Some Poles, Swedes, and Norwegians are found, and other nationalities to a less extent.

During the last few years, owing to the scarcity of labor, negroes have come from the South, particularly from Virginia, and a considerable number are at present employed as farm hands. but many of them return to the South for the winter months.

AGRICULTURE.

In 1683 Dutchess County was organized by the English. It then included the present county of Putnam and two towns of Columbia County. Following the act of organization the Provincial Government gave grants of land to individuals and organizations on the conditions that the claims of the Indians should be satisfied and the lands settled. The fact that the land was not disposed of to settlers in fee, but merely leased, delayed settlement for the first half century.

The original forest growth was deciduous, but there were some evergreens; hemlock was found in the ravines, ground hemlock on the higher ridges, black pine on the mountains, and tamarack in the swamps. Poplar and wild cherry were abundant. Oaks sprang up as a second growth in areas which had been swept by forest fires. Chestnut also formed a considerable part of the original forest.

The early settlers were vigorous and industrious. They cleared sufficient land to cultivate, and after clearing removed the larger

stones from the fields, so that cultivation would be less difficult. Maize and wheat were the first cultivated crops.

The population after the first half century steadily increased, and in 1756 Dutchess County had the second largest county population in the Province, and was the richest agriculturally. In 1800 the population had reached 50,000. Manufacturing was coming into importance by this time; hats were being made, and carding and fulling mills operated a number of looms. In 1813 Spofford said the county was "unequaled in the State for farm improvements and practical farming."

Wheat became the principal cultivated crop in the western part of the county within reach of the Hudson, and much of it was sent down the river to the cities for export. Oats, flax, and other crops were produced, and sheep and cattle were kept on every farm. Fallowing was practiced at this time, a field being left idle for a year or two and then again cultivated. The practice was employed rather because land was plentiful than for any other reason. Wheat yielded 20 to 25 bushels for one of seed to the acre, and wheat production increased during the first half of the nineteenth century. In 1835 over one-third of the grain shipped from the State came from Dutchess County.

The opening of the Erie Canal in 1825 brought western wheat into competition with the local product, and as the yields were becoming less because of continuous cropping the production of this staple gradually declined. The eastern part of the county meanwhile had developed along other agricultural lines. Its lack of river transportation and remoteness made the marketing of wheat expensive and tedious. The grasses, however, were nutritious and abundant and the farmers therefore raised live stock, which could be marketed much better than the grasses, although the stock had to be driven down the Harlem Valley 70 miles to New York. This system of farming produced sufficient manure to maintain and increase the productiveness of the soil.

The roads built in the latter part of the eighteenth century were an additional convenience from a transportation standpoint. The old "Post road" passed through the towns along the Hudson to New York City. Later a road was laid out through the Harlem Valley from New York to Bennington and soon a network of roads crossed the county in all directions.

According to the census of 1840 the staple crops of the county were hay, oats, corn, rye, wheat, buckwheat, barley, and potatoes, the cereals ranking in the order named according to the number of bushels produced. The figures of that date show a maximum production as compared with later reports, although it is very probable that the returns were larger prior to 1840, as a decline in the production of

cereals had been taking place. Hay outranked all the crops and has remained in the same position. The production of oats in 1840 was 1,360,000 bushels, and a steady decrease has taken place from decade to decade.

A decided decrease in wheat production, amounting to 100,000 bushels, occurred in the decade between 1840 and 1850. At the former date the production was 170,000 bushels. From 1850 the production of wheat has steadily decreased, but in the decades of 1870 and 1880 there was an increase, due, perhaps, to unusually favorable seasons for the years reported. There were 87,000 bushels of buckwheat reported in 1840, but the quantity produced has gradually decreased to about one-half the former production. The yields of barley varied throughout this time, being lowest during the last two decades. Potatoes were an important crop in 1840, the census figures showing a production of 590,000 bushels. This crop has gradually fallen off to about one-half that of 1840. The corn crop has fluctuated very little since 1840, being apparently a standard staple, although in 1870 and 1890 a decrease in yields was reported. The general average production for the seven decades has been 700,000 bushels.

The building of railroads in the forties allowed quicker transportation of western wheat and beef, and coincident with the opening of these roads came a further diminution in the production of wheat and beef cattle in this county. In other ways the railroads were beneficial. In 1849 the Hudson River Railroad, now the New York Central, was built as far north as Poughkeepsie, and in 1851 was extended to Albany. At this time the Harlem Division of the New York Central Railroad was completed through the eastern part of the county, and the value of town property along this line was doubled. As a result of western competition in beef cattle, the farmers of Dutchess County in the eastern and later in the western part turned their attention to dairying. There was an additional reason for this. The railroads offered facilities for the quick shipment of more or less perishable dairy products to the cities, New York in particular, where the increasing population created an active and steady demand for these commodities. Dutchess County was exceptionally situated to provide these markets, being only a few hours distant by rail. In the eastern part of the county sheep raising was also taken up. In 1840 the census returns gave 216,000 as the number of sheep in the county, but in the next decade the number had decreased one-half, and to-day, on account of gradual decline, the industry is of minor importance.

The interior of the county was opened up by the building of the Newburg, Dutchess and Connecticut Railroad in 1869, which made possible the shipment of milk to the New York market from this section. The Poughkeepsie and Eastern Railroad was built in 1870–1872, the Rhinebeck and Connecticut in 1874, and the branch road

from Hopewell to Brewster in 1881. These roads furnished adequate shipping facilities for the remainder of the county previously untouched by railroad lines.

Dairying is now the most important industry in the county. Its development since 1850 has been steady, 18,000 milk cows being reported by the census of that year. The number has now doubled. There has been no appreciable increase in the number of cattle other than milk cows.

The milk at first was made into butter and cheese. Cheese making did not prove profitable, however, and is not now important. After 1860 butter making became less general and milk shipments increased. Butter making is still of some importance as an industry, however, the census showing the number of pounds made in 1899 as 690,000 and the milk sold as 13,000,000 gallons; an increase in the latter of 5,000,000 gallons since 1870, and a decrease in the former of 2,000,000 pounds since 1850.

The farming is more specialized at present in this county than at any time in its history. Dairying being the principal industry, crops are grown with reference to supplying the demand of the dairy. Milk is sold from nearly every farm, and milk stations are established at many points on all the railroads. In the vicinity of a milk depot the farmers bring in the milk by wagon, but from territory more distant from a depot it is carried to the nearest railroad station, where arrangements for keeping it are made, from which point it is sent to the central depot. At the depot the milk is separated and brought to a certain standard, cooled, bottled, and sent to market. The railroads run special trains with refrigerator cars suitable for carrying milk. As a general rule the farmer sells his milk to the various milk companies, rarely shipping it to market himself, except when producing certified milk. Certified milk brings about 3 cents more per quart than the uncertified. There are a number of dairies scattered over the county producing certified milk, but there is a tendency to abandon its production on account of the very strict supervision exercised. On the whole the sanitary condition of the dairies is being improved. The price at which ordinary milk is bought is fixed by the milk distributing companies, and is not entirely satisfactory, being only one-half the market selling price, and varying with the seasons. It is claimed that the distributor makes a greater profit than the producer. This condition could probably be remedied by united effort on the part of the dairymen; for although the quantity of milk marketed or sold by each is small it would be possible by combination to obtain better prices than from the companies. The quality of milk is probably much better under the present arrangement than it would be if each individual sent his supply to market

independently. Some of the milk is condensed, and there is a large milk-condensing establishment at Wassaic.

The dairy cows are almost entirely grades; those of Jersey and Holstein blood are preferred and are most common.

In order to furnish feed for the dairy cattle, a large part of every farm must necessarily be in grass for hay and pasture. Of the average-size farm four-fifths of the improved land is in grass and something over one-half is in more or less permanent pasture. The average farm cuts 30 acres of hay, averaging slightly over 1 ton to the acre, although some fields which have been cut for hay for a long time do not yield more than one-fourth ton per acre. With better treatment and application of fertilizers, 2 tons or more can be obtained.

Timothy and redtop and some clover are the principal hay grasses. Oats is also largely cured for hay or used as a green soiling crop, comparatively little being thrashed. Corn is next to hay in importance, its acreage being about one-fourth that of hay. Corn is largely made up into ensilage, most of the varieties grown being suitable for that purpose. Silos are very common throughout the county, and the use of corn for ensilage is the most economical and profitable method of feeding. Some of the milk companies object to the use of ensilage, especially when the milk is to be condensed, alleging that it has a peculiar effect on the condensed product.

Wheat is grown, but not universally. Buckwheat is sown on most farms, especially on the slaty land, where it succeeds fairly well, and is no doubt one of the best crops on that type of soil. The average yield per acre of buckwheat in 1899 was about 15 bushels, of wheat and of rye 14 bushels, of oats 23 bushels, and of corn 29 bushels. Potatoes are grown universally, but in small patches, barely enough being produced for home consumption. On the gravelly and sandy valley soils and river terraces some fields were seen where this crop was being grown for market. The average acre yield is low, being but 80 bushels, according to the last census.

Orcharding, particularly of apples, supplements dairying. There are a number of large orchards, but most of them are small. The soils and climate are suited to the growing of apples, and labor, which at other times is scarce, can be obtained during the picking season from the cities, as at this time better wages are paid than usual. Peaches, plums, cherries, and some other fruits are also produced to a limited extent. The value of orchard products in 1899 was reported as $377,427. These figures represent a substantial progress, as in 1850 the value of orchard products was $15,886; in 1860, $92,189; and in 1870, $173,148.

The Baldwin apple is the favorite, but the King, Rhode Island Greening, Pippin, and a number of other varieties are grown. Some

of the best fruit finds its way into the export trade, particularly to England. Newtown Pippins are all sent to the cities, and the red varieties of apples are now in demand for the export trade.

Indications point to a greater fruit production in the county. Some years ago the growing of grapes on the slopes of the Fishkill Mountains and along the Hudson was quite an important industry, but this has been almost wholly abandoned. In the eastern valley, near the town of Dover, some tobacco, both wrapper and binder, was formerly produced. This industry was started in the fifties on a commercial scale, reached its height in 1880 with 280 acres with a yield of 400,000 pounds, and since that time has gradually fallen off and is still declining. The average yield is about 1,500 pounds per acre. The lower lying gravelly phases of the upland soils (Gloucester loam and Gloucester stony loam) and the gravelly soil (Merrimac gravelly loam) of the valley are the soils on which tobacco is planted.

Violets are an important special crop, particularly in the vicinity of Rhinebeck, and their superiority has made this section widely known throughout the country. There are over 100 commercial growers near this town, and a few are located in Red Hook, to the north, and in towns to the east. The soil in that section has proven well adapted to their production. Although the growers claim that the climate is important, it is probable that the soil is the determining factor. The soil used for the most part is the Dutchess stony loam, although some other soils are also used in different localities. New soil is selected each year and the practice is not to use it again, although it is probable that it could be used after an interval of rest.

Much of the merchantable timber has been removed, but considerable cordwood is cut. Quite a large area is still forested, the growth being chiefly oak and chestnut. Locust and cedar grow abundantly around the fields, and if these were more extensively grown for fence posts they would undoubtedly bring good returns. All the soils support a grass sod, but the limestone soils are prized particularly as grass land, for hay and pasture, and for general farming. The soil from the dolomites is not quite so strong, but has a comparatively high value. The limestone soils will also grow the heaviest corn crops. All the upland soils are good grass soils, but the Gloucester loam and the Dutchess silt loam are the heaviest, strongest, and least stony of these. The Hudson clay loam is also a strong grass soil, and in Columbia County, to the north, is used for grapes. All of the upland soils where drainage is good and the location favorable are good types for fruit. Apples on the Dutchess silt loam, however, though of excellent flavor and keeping quality, do not, as a general rule, color so deeply and so uniformly as on the slaty lands and the Dutchess stony loam. This latter soil is particularly important in fruit production in the town of Red Hook. Climate in this region seems

to be the controlling factor, as farther inland the fruit does not do so well, even on the same soils. The gravelly loam of the stream valleys and the gravelly and sandy soils of the terraces mature early varieties well, and the fruit has a good color and fine flavor.

The gravelly loam in the valleys is a fairly good corn soil, especially where not too leachy. The lighter soils do well in potatoes, tomatoes, and garden crops. The Hudson fine sandy loam is well adapted to small fruits and trucking, but very little truck is produced.

Crop rotation is practiced to some extent, but no system is followed closely. The rotation includes corn one year, oats or rye one or two years, then grass for hay two or three seasons, followed by a year or two of pasturing. The soil is fairly well prepared for seeding and receives good cultivation even under present labor conditions. Farm machinery is used where the soil is not too slaty and stony, and generous quantities of fertilizers are applied. The manure on the dairy farms is applied to the fields, but more care could be taken to prevent waste. Instead of leaving it in the barnyard it would be better to apply it to the meadows in the winter as made, so that it could be utilized to the best advantage. Corn land is always manured heavily. Some lime has been burned in the county and applied to the land, but the practice is not common. It has always proved beneficial and should be used more generally. Orchard trees are grown in grass sod and the grass cut and left for mulch, or, more generally, sheep and hogs are turned in. Many orchardists would prefer to cultivate the orchards, but do not do so, as labor is scarce. Spraying is practiced by only a few growers, although the cankerworm in some places has done much injury.

The demand for labor is active, especially on the dairy farms. In recent years foreigners have been used for this work, principally Italians, with a few Danes and Poles. Some colored labor is now coming in from the South, especially from Virginia. The wage paid them is about $20 a month and board.

Ninety-one per cent of the land in Dutchess County is in farms, 75 per cent being improved. Since 1890 the percentage of improved land has fallen, as 87 per cent at that time was improved. This condition may be due to labor conditions, some of the land formerly cultivated being allowed to revert to forest. The average size of farms is 132 acres, a slight increase in the last thirty years. Much of the land is included in large estates containing several thousand acres. The tendency, especially along the Hudson River, is to make these estates larger. About 67 per cent of the farms are operated by the owners. Renting is practiced both on a share and on a cash basis. There are a number of estates managed by a farm manager or superintendent.

The value of the land according to the last census is, on the average, $44 an acre. This shows a decided decline, as in 1880 the average value was $73 an acre. The average value per acre when applied

to farming lands is too high, as the average is greatly increased by the high price of land near the Hudson in the large estates. Farm values vary greatly, the rougher and more stony lands commanding comparatively low prices, not more than a few dollars an acre, and the better class of lands bringing very high prices, depending, of course, on nearness to railroads and general desirableness. It is almost impossible to state definite acreage values for the land in this county, on account of the many factors which influence values.

The farms have an appearance of thrift and prosperity; the houses are commodious, well painted, and in good repair; the outbuildings and barns for dairy stock are large and well kept, and the fields are fenced with stone walls. The taking of summer boarders is universal, and adds considerably to the farm income. There are also several summer hotels in the county, which offer opportunities for disposing of farm products near at hand. The country roads are good, and many of the homes have telephones, and the rural free delivery of mail is general.

At the present time the greater number of the farmers have to purchase grain, as not enough is produced on the farms to feed the stock, and this outlay cuts down the net returns. A leguminous crop would help to eliminate this expenditure, and should form a part in the crop rotation on every farm. Clover has succeeded in the county, and though difficulty is experienced in getting it to grow the failure may probably be attributed to poor seed. The effort should be made to obtain good seed, as the crop is nutritious and suited to the needs of dairying. Soy beans, no doubt, would succeed and, like clover, would be a good soiling crop and improve the land. Alfalfa would doubtless succeed on the limestone soils, as it has done well on similar soils in other parts of the State. The land should not be left in grass sod for so long a period as in the present crop rotation.

The sandy and gravelly types should be devoted to truck crops and small fruits, and the areas too rough and stony to cultivate with fair profit should be allowed to return to forest and a good system of forestry followed.

SOILS.

A comparatively large number of soils were recognized and mapped in Dutchess County. In addition to areas of Rock outcrop, Rough stony land, Meadow, and Madeland—self-explanatory terms used in soil classification to denote a condition rather than a difference in soil texture—seventeen types of soil were mapped. These soils may be separated into two general groups with relation to position and origin—those in the uplands closely associated with the various underlying rock formations partly of residual and partly of glacial origin; and those in the interior stream valleys and along the

Hudson River, made up of water-transported materials or sediments. The upland soils may be again separated with reference to the kind of rock from which derived or with which each is associated, and the sedimentary soils may be separated not only upon differences in the kind of sediments transported and deposited, but also as to the place, manner, and time of deposition. These divisions, it may be said, correspond to the soil series in soil classification, each series representing a group of soils of like derivation and mode of formation, each type unit being a separation based upon textural and structural differences or upon some other important factor, such as the kind and quantity of stone in the soil.

Thus the upland group of soils associated with the underlying rock formations was found to embrace eight soil types, representing three soil series, and the sedimentary group ten soil types, representing four soil series.

All the soil material has been more or less affected by glaciation, being either derived in part from glacial till as originally deposited or as more or less modified by other agencies since deposition. Glaciation, however, on the whole, was rather feeble; in some parts the ice sheet must have merely scoured off the shallow soil mantle and broken the underlying rock ledges. In such places the resulting soil is mainly residual, although in places influenced by glacial material. In other places some of the rocks were ground to powder or were merely rounded off and the material left in place, or again, it may have been transported possibly some distance and deposited to a considerable depth, leaving the surface smooth and rounded. The direction of the glacier being along the longer axis of the rock beds, there was very little intermingling of material from the different rock formations; hence the soil material formed by the breaking down of the underlying rock predominates and determines the nature and character of the soil. Some of the material may have been transported, but if so it has been carried along the same rock formation and has therefore the same derivation. Thus, because of the close relation between the soils and the rocks, it is necessary to have a knowledge of the underlying formations to understand the resulting soils.

The rocks are of the older formations in the geological scale, ranging from pre-Cambrian to Silurian, and varying from igneous, metamorphic, crystalline rocks to sedimentary rocks, the latter consisting of shales, slates, grits, limestones, and dolomites, with variations and blendings in all the forms.

The oldest formation occupies the southern and eastern parts of the county, making up the Fishkill Mountains, a part of the Hudson Highlands, and the mountainous ridges along the Dover-Pawling Valley and the Connecticut State line. It consists of granite flanked

on the sides by a thin-banded micaceous gneiss, the whole formation being known as the Fordham gneiss. Its topography is mountainous. Glaciation evidently took place, although it was not very severe, but there occur on the surface large and often huge bowlders that are more or less rounded. Because of their number and the outcrops of rock on the surface, as well as the general rough topography, the greater part of this formation has been mapped either as Rough stony land or Rock outcrop. Less stony areas occur, however, and these have given rise to the Gloucester stony loam, a soil type also extensively developed and distributed over New England. In the southeastern corner of the county, forming the ridge known as Quaker Hill, is the Hudson schist, a metamorphic rock of Silurian age. It is a mica schist from which is derived the mica found so abundantly in the soil mass, but the rock varies slightly, blending on the one hand into micaceous thin-banded gneiss and on the other into the less micaceous slate of the Hudson slate group. The Hudson schist is a comparatively soft rock which was easily ground up by the ice, and as a result a considerable depth of soil material was left and the surface smoothed. A comparatively small quantity of stone is found in the soil. This formation gives rise to the type of soil called the Gloucester loam, a type not previously encountered, and to small areas of Rough stony land.

Forming the floor of the eastern valley, the Pawling-Dover-Amenia Valley, is another rock formation known as Stockbridge dolomite of Cambro-Silurian age, consisting of distinctly bedded and generally coarsely crystalline limestone and dolomite, in some places highly metamorphosed, forming a dolomitic marble. Aside from the agricultural value of the soil, the marble has a high commercial value. The Stockbridge dolomite is separated from the gneiss formation by a bed of quartzite, which has no influence on the soils, as it is included with the Rough stony land of the gneiss. On the east side of the valley it grades into the Hudson schist. This rock decomposes and disintegrates easily, and the soil formed is of a fine, silty, sandy texture and fairly productive. The extent of this type is not large, the continuity of the areas being broken by overwash of glacial gravel. The soil is doubtless largely residual, although modified to some extent by glacial material. The resulting soil has been called the Dover fine sandy loam.

To the west of all these formations and underlying the greater part of the county is what is known geologically as the Hudson River group or series of rocks, of sedimentary origin and of Silurian age. This group consists of a series of slates, shales, grits, limestones, and siliceous and calcareous breccias and conglomerates. These have been modified or metamorphosed to some extent in places by the intrusion of plutonic rocks and have been broken up and

tilted at various angles to the surface, as well as bent, wrinkled, and contorted in almost every conceivable manner, and elevated into hills and ridges. They are stratified and the different beds alternate a great number of times without any regular sequence. Within the group there are varying combinations in the different beds which grade into one another, as, for example, shales and slates which range from argillaceous to gritty or sandy, and grits, from shaly or slaty to massive or thickly bedded. Some beds are highly calcareous, while others are not. The slates and shales are generally dark brown, blue, or black, and the grits are gray, greenish, and bluish gray. Near the Hudson the rocks are mostly grits and give rise to the Dutchess stony loam. To the eastward the slates predominate. East of Wappinger Creek the formation is claimed to be more or less metamorphosed, developing talcose and chloritic slates in places, and even hydromica slates approaching schist. The less severely glaciated part gives rise to the Dutchess slate loam, a soil containing large and varying quantities of slate fragments and larger stones and slabs. These two soils seem to be largely residual, and only here and there contain any considerable quantity of glacial till. To ice action possibly, as well as to postglacial weathering and erosion, may be due the breaking down of the rocks in place. Through the central part of the county glaciation was more severe, and smooth glaciated hills are scattered here and there through the rougher parts. In these places is found a greater depth of soil material—a heterogeneous mass of fine earth, gravel, and stones—which indicates that the mass is largely glacial and probably transported, although derived from rocks similar to those of the underlying beds. The depth of material ranges from a few inches to an unknown number of feet. The effect on the topography has been to smooth the surface, and some glacial forms, such as drumlin-shaped hills, occur. The soil mass is compact, making the soil more retentive of moisture and apparently heavier than the more stony soils. The soil has intermingled with it, however, varying quantities of stone and gravel, and on the surface some bowlders as well. It is affected to some extent, especially where shallow, by the underlying rocks, which vary slightly, and the soil is sometimes more silty and again more sandy than is usual. As a whole, the soil is a granular, friable, light silt or silty loam. It has been classed as a silt loam under the name Dutchess silt loam.

Limestone areas occur in most of the valleys and give rise to a heavier soil than that formed by the dolomites in the eastern part of the county, the type developed being a light silt loam. The soil mass is largely made up of residual material, but has been affected to some extent by glacial drift. The topography is ridgy and rather rough, with numerous outcropping ledges of limestone. The soil

has been called the Dover loam and is a comparatively strong, productive, and desirable soil.

All of the foregoing soils may be classed as glacio-residual, formed by the intermingling of transported glacial drift and material derived from the breaking down of the underlying rocks. The overlying soils derived from the igneous and metamorphic rocks are included in the Gloucester series, those from limestones and dolomites in the Dover series, and those occurring in the Hudson River group in the Dutchess series. The last two named series are new in the soil classification, but the first mentioned occurs generally throughout New England.

The sedimentary group of soils consists of three classes, separated on a basis of manner of formation and place of deposition—that is, modified or reworked glacial drift, glacial lake, and alluvial. All of these are, in fact, reworked glacial material transported and deposited under different conditions. The first two classes were formed at the close of the Glacial epoch, but the alluvium is of recent origin. The modified drift soils occur in the interior valleys as gravelly overwash plains and gravelly dumps. At the close of the Glacial epoch, when the ice was melting and receding, the glacial streams from the ice front carried large quantities of glacial debris, consisting of gravel and fine earth, which was reworked and deposited in layers or strata by the water in the stream valleys. As evidenced by the coarseness of the material this deposition was probably made in swift running water. Three types of soil were recognized, a gravelly loam, a gravelly sandy loam, and a loam, which have been given the series name of Merrimac. The glacial lake or lacustrine soils represent sediments deposited in a glacial lake. At the close of the Glacial epoch, when the ice was all melted in the Hudson Valley, except in the Hudson gorge now occupied by the river, the river was obstructed or dammed at the Highlands and a lake was formed along the river, named by geologists Lake Albany. The water carried for the most part sediments which were slowly deposited, forming the great and valuable deposits of clay now used for brickmaking along the river. Over a great part of it, however, sandy deposits were made, forming the sandy types of soil, which must have been deposited in shallow and moving waters. Four types of soil have resulted, varying in texture from a silty clay loam to a medium sandy loam. These have been included in a new series called the Hudson series.

The alluvial soils are the recently formed flood plains deposits along the stream courses and are not extensive, as the streams are still cutting their channels rather than forming flood plains. Two types of soil were found, a fine sandy loam, occurring with or in some places being the wash from the soils derived from the metamor-

phic crystalline rocks in the eastern part of the county. This soil has been correlated with the Podunk soils occurring along the Connecticut and Merrimac rivers in New England. The other type is a variable soil classed as a silt loam, called the Huntington silt loam, occurring along streams throughout most of the county.

The different soil types, together with areas of Rock outcrop, Rough stony land, and Meadow, are shown by colors on the accompanying map, and Madeland by symbol.

The name and actual and relative extent of each soil are given in the following table:

Areas of different soils.

Soil.	Acres.	Per cent.	Soil.	Acres.	Per cent.
Dutchess silt loam	117,184	22.9	Dover fine sandy loam	8,512	1.7
Dutchess slate loam	94,144	18.4	Gloucester stony loam	8,256	1.6
Rough stony land	77,440	15.1	Hudson fine sandy loam	6,400	1.2
Dutchess stony loam	51,776	10.1	Hudson loam	3,904	.8
Merrimac gravelly loam	41,216	8.1	Rock outcrop	3,328	.6
Dover loam	28,800	5.6	Hudson sandy loam	1,856	.4
Meadow	24,192	4.8	Merrimac loam	1,600	.3
Huntington silt loam	11,200	2.2	Rumsey loam	1,088	.2
Gloucester loam	10,752	2.1	Madeland	448	.1
Hudson clay loam	9,984	1.9	Podunk fine sandy loam	192	.....
Merrimac gravelly sandy loam	9,600	1.9	Total	511,872	.....

DUTCHESS SILT LOAM.

The Dutchess silt loam is the most widely distributed soil type found in Dutchess County. It has been formed from a shallow mantle of glacial till spread over a variety of rocks, each of which to some extent has influenced the soil formation, causing here and there slight textural differences, as well as some differences in color and in the kind of rock fragments left in the soil mass or strewn upon the surface. Upon the whole, however, it is a fairly uniform type and one readily recognized. A profile section of the Dutchess silt loam would show a surface soil 8 or 10 inches deep consisting of a friable silt loam or silty loam of light or yellowish-brown color, underlain by similar material of a lighter or yellowish color and somewhat more compact. The demarcation between the soil and subsoil is fairly distinct, the first few inches of the subsoil being lighter in color than the soil and changing to a brighter yellow.

The mechanical analyses of typical samples of this type show that one-half or more of the fine earthy material is silt, about 10 per cent is clay, and about one-third is made up of the coarser grades, which are about equally divided between the very fine, fine, medium, and coarse sands, and fine gravels, the coarser particles being sufficient in quantity to give the soil a granular character.

It is possible that to some extent the friableness of the soil may be due to humus matter and the result of cultivation. The subsoil because of its compactness seems apparently heavier, but the analyses show little difference in texture. In places, however, the subsoil seems more sandy than the soil, which is probably attributable to the lack of organic matter, although where closely associated with the more gritty rocks it is actually more sandy.

The variations in the texture, however, are slight and are not sufficient to make separation possible. These variations are due to the character of the rocks from which the soil is derived, although the soil mass may not be derived directly from the immediate underlying rock. Where more closely associated with the gritty rocks, the soil is decidedly more gritty or sandy and in some locations might better be described as a gritty or sandy silty loam or light loam. Where it is associated with the argillaceous slates the material is possibly more silty, and where the rocks are more calcareous the material is heavier and has a slightly reddish cast. In the valley areas occurring in the vicinity of Millerton, where the metamorphosed slates carry more carbonaceous beds, the soil is also pronouncedly silty, of a darker color, and somewhat micaceous, approaching the character of the Gloucester loam overlying the Hudson schist. In this valley it is also associated with limestone and dolomite beds, and though influenced slightly by them is often regarded by the farmers as limestone land and highly desirable because of the generally small stone content. A still further variation is that found on the "wet slopes," as they are called, of the hills. These slopes represent a condition of comparatively poor drainage induced by the imperviousness of the compact soil material. The soil is somewhat more silty here and is drab colored, while the subsoil is possibly a little heavier, somewhat plastic, and mottled drab and yellow or sometimes simply light drab in color.

The soil is spoken of commonly by the farmers as cold, wet clay. In fact, as a whole, it is regarded by them as rather heavy and clayey. The depth of the soil mass is variable, usually stones are numerous or the underlying rock so close to the surface that the soil auger could not penetrate to the full depth—36 inches—generally reaching a depth of only 18 to 24 inches, except where the rock content was less than usual. The soil mantle in places, however, is often of unknown depth. The immediate subsoil and that below is as a rule quite compact, the color also changing with depth from yellowish to drab or farther down to a bluish color. The material is often sufficiently compact to give the impression of hardpan and holds water readily. Varying quantities of gravel and stones are found in the soil mass and scattered upon the surface. These stones consist of fine gravelly fragments, rounded gravel, cobbles, or angular and

subangular slabby pieces of rock. Small slate and shale fragments are often found, particularly where ledges of these rocks come close to the surface or protrude above it. Extensive areas where the fragments were of sufficient quantity were included in the Dutchess slate loam. The gravel and stones are more abundant in the subsoil, as the surface has been cleared of the larger stones and bowlders. The removed stones have been used to build the field walls, being quite sufficient for this purpose. The north slopes of the hills are less stony, the stones not being sufficient to build the fences, and wire fences are more in evidence here than on the southern slopes. This absence of stones is explained by the fact that the ice sheet scoured over the north slope, carrying the stones over the hilltops and dropping them in the till on the south slope. The north slopes are generally the wettest, while the quantity of stone on the south slope assists drainage, making the soil drier.

As noted already, the Dutchess silt loam is the most extensive soil in the county, covering nearly one-fourth of the total area. It is found in all the towns except Pawling, though in some it is barely more than represented. The greatest development is diagonally through the central part of the county, the area increasing somewhat to the northeast. In the towns of Lagrange and Wappinger its extent is quite appreciable, while in the towns to the north of Wappinger, along the Hudson, the areas are smaller and not numerous. There are some small areas scattered throughout the slate belt from Pleasant Valley northward. These, as a rule, are irregular and not continuous, being broken by areas of other soils. This type is hilly and to some extent made up of ridges. The hills range from 300 to 400 feet in the extreme southwestern part of the county and along the Hudson to 1,200 feet or more in the northeastern part, the elevation gradually increasing to the north and east. The surface configuration of these hills and ridges is essentially that peculiar to glaciation in that they have been smoothed and rounded by the passing of the ice sheet and the deposition of glacial debris. The hills in most cases are elongated and more or less drumlinoid in shape. The north and south slopes are for the most part long and gentle, while the sides of the hills and ridges, especially in the upper parts, are often rather steep, but all are capable of cultivation. The higher hills and ridges in the county to the east and north have long, sweeping, smooth slopes.

The position of this soil on hills and ridges and their slopes allows of good surface drainage, but because of the imperviousness of the subsoil the slopes are often wet and swamp grasses are found growing on them. For such a crop as corn they require drainage. This can be accomplished by stone drains or in some instances by blind ditches. No doubt tiling would also prove beneficial on many of the

slopes. The moisture-holding capacity is sufficient to make the type as a whole comparatively wet and cold, and hence a late soil.

The Dutchess silt loam is largely of glacial origin. It is, however, closely related to the underlying rocks, in that it has been derived from the pulverization of similar rocks or rock of the same formation by the grinding and crushing of the ice sheet. The direction of the ice movement was along the rock beds and not across them, so that little intermingling occurred from the sides. The underlying rock, however, particularly where the soil mantle is shallow, has influenced the overlying soil to some extent. To this fact is due the slight textural and color variations in the soil mass. The underlying formation is the Hudson River group of rocks of Silurian age, consisting of a series of shales, slates, and grits in thin beds, alternating a great number of times, varying in composition and merging into one another by imperceptible degrees. Wherever these different rocks are found close to the surface the stone on the surface and in the soil mass will be found to be similar to the underlying rock.

Practically all of the Dutchess silt loam has been cleared and cultivated, and it is the principal farming soil in the county. It is considered a heavy soil, and on account of its moisture-holding capacity is well suited to grass and hay. It is used principally as pasture land for stock and for making hay, as dairying is the principal industry in the county. Timothy and redtop are the grasses most commonly produced on this soil, yielding about 1 ton per acre, but where the land is treated with barnyard manure and is reseeded more frequently the yields are much greater. Clover formerly made good yields, but at present is not so succesfully grown. Other forage crops do well, and it would be very desirable to introduce at least one leguminous crop. Soy beans would doubtless succeed. Fair crops of corn, especially ensilage corn, are obtained, except on the higher elevations, where the climatic conditions are adverse. Wheat formerly made good yields on this soil. Rye is now grown universally, being valued for its straw, which is commonly sold for packing purposes. The grain is thrashed with the old-fashioned flail, in order to prevent injury to the straw from breaking. Oats are grown quite generally and make fair yields. Potatoes are produced on every farm and give returns of 100 to 150 bushels or more to the acre. Potatoes should be more extensively produced. Apples succeed and orchards are found on practically every farm, many of them being of commercial size. The apples produced in the county are grown mainly upon this type of soil. Although there are a number of commercial orchards, nevertheless the general practice is dairying, supplemented by apple growing. The varieties produced are the Baldwin, King, Rhode Island Greening, and a number of others. The stony slopes are desirable locations for orchards, as the drainage is usually good. A

northerly slope is preferred. Some peaches are produced, and there are a few orchards of commercial size in the central and southern parts of the county. Plums also do well, and the few plum trees seen on nearly every farm were bearing considerable fruit.

As a rule the farms on this type are kept in fairly good condition. This is made possible by the practice of dairying, by which large quantities of manure are made and applied to the land. Besides this, much commercial fertilizer is used. The farm buildings are good, and there are numerous outbuildings for housing stock, and indications in general point to a prosperous condition among the farmers.

The assessed value of the farms on this soil is next to that of the limestone lands. Values vary, depending upon a variety of conditions. The general value is quite high.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Dutchess silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
17148, 17164, 18266.	Soil	4.0	7.4	3.8	8.7	4.6	60.6	10.9
17149, 17165, 18267.	Subsoil	4.2	8.0	3.9	9.4	4.0	57.3	13.2

DUTCHESS SLATE LOAM.

The surface soil of the Dutchess slate loam consists of light-brown or yellowish-brown, fine-textured shaly or slaty loam or silty loam, often quite gritty on account of the large content of fine sand, underlain by lighter colored or yellowish material of the same texture as the soil, or in some places by a plastic silty clay loam. Both the soil and subsoil, except in the more sandy phases, have, for the most part, a smooth and often greasy feel, imparted by small, thin, shaly or talcose flakes. In the soil and the subsoil and strewn upon the surface occur varying quantities of shaly and slaty flakes or chips or larger slabby pieces. In some places the larger pieces have been removed and used for building walls about the fields, there usually being a sufficient quantity for that purpose, so that here the remaining rock material is so small as to render the soil slaty or shaly rather than stony. To some extent rounded gravel and stones from glacial till are found intermingled with the material from the underlying rocks, but the quantity is not large except in occasional small areas. Here and there these fragments are very thin, flaky pieces, of pearly appearance, derived from the breaking down of talcose or hydro-mica slates, and these have a smooth, soapy feel. In other places the material may be coarser, more or less talcose, or it may be that the rock

is a coarser slate, either argillaceous or arenaceous, breaking into larger, more conspicuous fragments.

The fragments of sandy shales, and especially of the shaly grits, are irregular-shaped chips, rather than flakes. These fragments were of so varied a nature and so intermingled as to render separation on the basis of a difference in their character impracticable, but the resulting soils were apparently identical, or nearly identical, so that the present grouping may be considered satisfactory. Numerous outcropping ledges occur, making the surface almost as rough as that of Rough stony land; in fact, areas where the outcrop covered a considerable extent were included under Rough stony land.

The soil formation is shallow, varying from a few inches to about 24 inches or less in depth, and averaging from 15 to 18 inches. The surface soil is generally 6 to 8 inches in depth. The presence of organic matter in the soil makes it darker in color and apparently more loamy, and this difference in color marks its separation from the subsoil.

The Dutchess slate loam is an extensive soil type and occurs in all towns except those in the south and southeastern parts of the county. Its greatest extent is from the town of Lagrange and Pleasant Valley northward, where it occurs as a somewhat broader belt with numerous smaller irregular areas scattered over the county. The surface of the Dutchess slate loam is the roughest of any of the cultivable soil types of the county and has a topography distinctly its own and readily recognized. These areas are very slightly glaciated, at any rate not sufficiently to render the surface smooth, so that sharp rock ledge outcrops are common. Hills and ridges of uneven surface and of varying heights are quite numerous; the highest of the slaty hills reach 1,000 feet, but for the most part they are from 400 to 700 feet in elevation and rise from 200 to 300 feet above the general level of the county. The hills and ridges have in some places steep and in some precipitous slopes, but they are generally more or less cultivable. Between knolls and hills occur wet depressions filled with swampy vegetation.

Smaller bodies of Dutchess slate loam are occasionally found throughout the extent of the Dutchess silt loam. The occurrence of these bodies is usually upon the rougher and steeper slopes as well as on the sharp tops of hills and ridges.

The generally uneven and steep slope of the surface permits rapid surface drainage, and partings in the underlying rock also allow ready passage of water from the surface downward so that the soil is droughty, and during the summer months pastures and cultivated crops often suffer for need of moisture and yields are small, especially in abnormally dry seasons. Numerous springs occur, as well as large numbers of small brooks and creeks. Most of these carry water dur-

ing wet times, but during dry spells generally go dry or at best carry a very small quantity of water.

The Dutchess slate loam is probably mostly residual, though to some extent glacial, as indicated by the rounded gravel, stones, and bowlders found in and upon the surface over practically every part of it. Yet the glacial material is probably only a small part of the soil mass as a whole. The underlying rocks giving rise to this soil, though closely related, are variable to some extent. They comprise a group of sedimentary rocks known geologically as the Hudson Group and consist of interbedded shales, slates, and grits. These formations cover the larger part of the county and have been more or less metamorphosed by pressure and heat, until the greater part has been changed to slate or has even approximated a schist. The shales are gritty or sandy to clayey and the slate gritty or clayey to talcose and chloritic, and some of the beds are more or less calcareous.

From the predominance of the slaty fragments the Dutchess slate loam is known generally as "slate" or "slaty" land. Its rough surface makes it in general a hard soil to till, otherwise the soil itself is easily handled. Where underlying ledges occur near the surface they are so weathered that the plow will cut through them, while with harder rocks the plow is stopped as in case of the limestone and dolomite soils. In places the number of fragments is so large that cultivation is interfered with.

The larger part of the "slaty" lands is used for grasses for hay and pasturage. This seems to be its best use. The hay crop is not nearly so heavy as on the Dutchess silt loam nor does pasturage hold out so well, and during dry spells the pasturage becomes very poor. Its advantage is the earliness of pasturage in spring, the result of better drainage conditions. The quality of the cultivated crops is good, but the average yields are low. A long-season crop like corn, with rare exceptions, makes poor yields, for just when the crop needs rain the most the soil is driest. Cereal crops that do not have to go through the summer do better, and rye and oats make fair yields. Probably the best crop, after grass, on this soil is buckwheat, some being grown on most farms.

Scattering apple trees and quite a number of successful orchards were seen growing on this soil. For success in this line the soil must be of sufficient depth and have good drainage. On the gentler slopes, especially the lower parts, trees, if given care and fertilized, return good yields. The fruit grown on such areas is desirable because it is usually well colored, firm, and of good flavor and keeping qualities. Pears and plums also succeed well.

In general the Dutchess slate loam is considered a light, thin soil requiring fertilization with either barnyard manure or commercial fertilizer, or both. A large proportion of it is really too rough to cul-

tivate without great difficulty, so that it is left in permanent pasture or in forest. Much of it has never been cleared and is covered by a forest growth, the best timber of which has already been removed. The timber consists of the deciduous trees of this region, with occasionally scrubby pines, and in the deep ravines or glens some hemlock. Chestnut and oaks are the predominating species and the cedar is common. The locust is also frequently found about cultivated fields. Much of this "slaty" land should be devoted to forestry, as such use will in the end bring better returns to the owner. Some of it could be left in pasture as at present, cultivating only the better lying fields. In the larger areas of the Dutchess slate loam the houses and barns are usually small and there are no large cultivated fields. Where not too far from the railroad, dairying or fruit growing is said to be the most profitable form of farming. Owners of this land not far from Rhinebeck are beginning to grow violets, generally as a side line in connection with dairying, and this is proving profitable. Where "slate" land occupies part of a farm composed in part of a better soil type, it affects the value of the whole farm very little, being utilized as permanent pasture land and woodland.

The assessed valuation of the slate land is about half that of other farm lands. On the market the farms bring the lowest price.

The average results of mechanical analyses of fine-earth samples of soil and subsoil of this type are given in the following table:

Mechanical analyses of Dutchess slate loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18261, 18263	Soil	7.5	11.4	4.0	8.0	8.1	46.0	14.0
18262, 18264	Subsoil	11.3	11.8	4.2	8.2	11.3	38.2	15.0

GLOUCESTER LOAM.

The surface soil of the Gloucester loam, to an average depth of 8 inches, consists of a light to dark-brown rather silty loam having a soft but slightly gritty feel. It contains without exception some mica, generally finely divided, varying in quantity but sufficient to be noticeable. In some places the flakes become much larger—an inch or more in diameter—and so abundant as to be seen several feet distant glistening in the sunlight. Where the content of this material is appreciable the soil has a soapy, greasy feel. The subsoil is a brownish yellow to light yellow in color and similar to the soil in texture though seemingly more sandy. It is, however, compact, and therefore retentive of moisture. The depth varies from 24 to 30 inches, where broken rock or bed rock occurs. The mica content in

the subsoil is greater than in the soil and the flakes usually larger. There are some fine rock fragments in the soil and subsoil, and some larger stones are encountered, but there does not seem to be a great quantity of the latter in the soil mass, as may be seen in road cuts, and the quantity on the surface was originally small. In general the stone content is much less than in any of the glaciated soil types.

The Gloucester loam occurs only in the towns of Pawling and Dover. Practically one large area, in which Rough stony land areas occur, mark its development. It occupies the tops and slopes of the highest ridge found east of the Pawling Valley along the Connecticut State line, a part of which is known as Quaker Hill. This ridge is broadly dome-shaped, has a rolling top with some secondary ridges, and the main slope is long and sweeping for a distance of several miles. The whole surface has been smoothed by glaciation, except the areas included under Rough stony land, and for the greater part, the slopes are gentle and capable of cultivation. The ridge rises about 700 feet or more above the Pawling Valley, its highest point on Quaker Hill being a little over 1,300 feet above sea level. The sloping surface allows good surface drainage, but the subsoil is so compact that it retains considerable water and the soil is spoken of as "wet and cold."

Of Glacial origin, the Gloucester loam, like the Gloucester stony loam, is influenced by the underlying rock probably even to a greater extent than the latter. It overlies a mica schist known as the Hudson schist, varying from a micaceous gneissoid rock on the one hand to a hard slate and nonmicaceous schist on the other. The breaking up of this rock has been the source of the mica in the soil, though the material may have been to some extent transported, so that the soil may not have been derived directly or entirely from the immediate underlying rock. The Gloucester loam is considered a heavy soil by the farmers. They say it works as a heavy soil and is "wet and cold." It gives large crops of hay—timothy, redtop, and clover. It will make 2 tons or more to the acre, and the better yields are obtained in the drier seasons, as the soil seems wet enough at ordinary times for grass. It makes fine pasturage, and the native grass sod is relatively permanent. Numbers of meadows have been sodded for long periods and are still productive, though this is in part due to frequent applications of barnyard manure.

Corn, as might be expected, does not do well except in the better drained places. On the higher situations the elevation is high for corn. On the slopes there are some apple orchards that are yielding well, but unless the soil is well drained orchards will not be profitable. The higher parts are not considered good locations for orchards. This soil would no doubt be greatly improved if drained by tile or by ditches. Recognizing the marked adaptation of the soil for grass,

the owners have nearly all their farms seeded down and follow dairying. The farms are large and well stocked, the dwellings and barns well built and commodious, and the region has the general air of prosperity. Good railroad facilities at Pawling, added to the general desirability of the land, cause farm values in this soil type to run quite high.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of this type:

Mechanical analyses of Gloucester loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
16995, 17166	Soil	5.3	9.0	4.9	15.7	10.4	45.5	9.5
16996, 17167	Subsoil	4.7	9.5	6.2	16.9	10.1	41.8	11.3

GLOUCESTER STONY LOAM.

The surface soil of the Gloucester stony loam consists of 8 inches of a light or grayish-brown to dark-brown loam with a rather soft feel. Usually small quantities of finely divided mica are present, though to a much less extent than in the Gloucester loam.

The upper subsoil is a light-brown loam or silty loam, generally more sandy than the soil, changing with increasing depth to a yellowish color and heavier texture. The deeper subsoil, though not cemented as in a true hardpan, is compact and impervious. Like the soil, it contains some finely divided mica, and both in the soil and subsoil and upon the surface are scattered small stone fragments, rounded gravel, and bowlders of a gneissoid rock. In places, as on Chestnut Ridge to the west of Pawling Valley, the gneissic or granitic bowlders occur as masses, often several feet in diameter and weighing several tons. In fact, some of the areas represent cultivable soil bodies in a general Rough stony land area. In the valleys and on the lower slopes of the Fishkill Mountains the bowlders are not so large or so numerous.

The Gloucester stony loam is not an extensive soil type and is confined to the towns in the southern and eastern parts of the county. It is found only in the Fishkill Mountains, their continuation, Chestnut Ridge, and the glacial slopes of the hills in the Pawling and Dover valleys extending into Amenia.

It occurs on the tops and slopes of the mountains and mountainous ridges, the surface not being very rough except where bowlders are seen. On the glaciated slopes of the hills and low mountains the surface is smooth and not generally so stony as in the mountains.

On account of position it has good surface drainage, but the compact subsoil is more or less impervious to water; hence the soil is

rather cold and wet and is therefore better suited to grass than to cultivated crops. The Gloucester stony loam is largely a glacial soil derived from glacial débris. However, the area it covers was for the most part only slightly glaciated, so that the resulting soil probably differs little from a true residual soil, as the material of the underlying rocks has been merely broken off and crushed and probably not moved very far. The gravel, stones, and bowlders are of the same material as the underlying rock, which is of pre-Cambrian age and known as the Fordham gneiss. In the parts where glaciation was more active the topography has been smoothed and the soil mass compacted.

The Gloucester stony loam is a fairly productive soil and for the most part is better adapted to grass for hay or pasturage than to cultivated crops. Much of it can best be used for pasture land. The higher and stony areas on the mountains and ridges are rather poor and being far removed from the milk stations on the railroads dairying is not profitable. Buckwheat does well on these higher areas, but for corn and fruit the elevation is in the main too great. In lower situations these crops apparently do well. On the lower slopes in the towns of Dover and Tenmile River, where the soil is quite gravelly, tobacco gives good results, and some is grown on most of the farms where the soil and position are favorable. Two types of tobacco are grown, Havana seed leaf and Broad leaf, the former making cigar wrapper and binder and the latter cigar binder and filler. The reported yields range from 1,500 to 2,000 pounds per acre. The forest growth on this soil is principally chestnut, with oaks and other deciduous species represented.

The mechanical analyses of a fine-earth sample of the soil and subsoil of the Gloucester stony loam are given in the following table:

Mechanical analyses of Gloucester stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
16997	Soil	4.3	7.3	4.3	13.8	15.2	46.9	8.5
16998	Subsoil	4.0	8.7	4.9	14.9	19.0	41.8	6.0

DUTCHESS STONY LOAM.

The surface soil of the Dutchess stony loam, to an average depth of 8 inches, consists of light-brown or yellowish-brown light silt loam or fine-textured loam, grading in some places to a rather heavy, fine sandy loam. The soil, though high in silt content, contains, however, appreciable quantities of sand particles, which, together with the fine gravelly fragments always present, make it granular and friable. Upon the surface and in the soil occur angular rock fragments of

varying sizes, usually not large, though there has been a sufficient quantity of the larger blocks to build walls about the fields. The rock fragments vary in quantity. Generally there is at least 20 per cent on the surface, though in some places it is completely covered by them. They consist of angular blocks or slabby pieces of thin-bedded sandstone or grit, more or less calcareous, or of a gritty shale or slate. Besides the fragments that come from or are similar to the underlying rock are found some rounded glacial gravel and bowlders.

The subsoil is for the most part of texture similar to the soil, though it varies from a more sandy material to material decidedly clayey, the latter occurring where a more calcareous rock underlies. The color of the subsoil is generally yellowish, but in its lower parts often changes to slightly reddish or reddish yellow. The subsoil contains considerable quantities of fine rock fragments the size of fine gravel or larger, as well as angular blocks of the underlying rock. The bed rock on an average comes within 18 inches of the surface and on tops of ridges much nearer, so that the soil formation is only a few inches in depth, or, as is common, the rock outcrops, the ledges being so numerous in places as to warrant classification as Rough stony land. In general rock outcrops are a prominent feature in this soil.

The Dutchess stony loam covers a large area in Dutchess County, though limited to its western part, being the first upland type from the Hudson River. It occurs in a belt north from Poughkeepsie through the towns of Pleasant Valley, Hyde Park, Clinton, Rhinebeck, and Red Hook, with a detached area in Milan. This larger belt, though continuous, includes a number of areas of other soil types. Another area occurs in the towns of Wappingers Falls and Fishkill.

The surface of the Dutchess stony loam is very uneven and is marked by a series of ridges and hills generally low, but sometimes reaching an elevation of 200 or 300 feet above the general level. The surface of the ridges is marked by knolls here and there in which the underlying rock is generally exposed. On the lower situations, as in the valleys, the topography is characterized by disconnected rocky, irregular knolls, between which are generally found small swampy areas. The topography as a whole is so distinct that the type may be readily recognized by this characteristic alone.

The unevenness of the surface causes good surface drainage, while the granular character of the soil, the presence of stone fragments, and the partings in the underlying rock beds allow relatively free movement of the soil water, and yet the type is fairly retentive of moisture and of fertilizers. However, between the hills, as previously stated, are wet areas without outlets. When of sufficient size these have been mapped as a different soil type. Many small brooks and creeks traverse the areas of this soil.

The area covered by the Dutchess stony loam has been subjected to glaciation, but the work of the ice was not great. The soil seems to be largely derived from the underlying rocks or at least from similar rocks, the mass being transported, if at all, only a short distance. The material was pushed along and subjected only to slight grinding, as is evidenced by the angularity of the rocks on the surface and the absence of the finer glacial till or bowlder clay. That glacial debris was dropped is shown by the presence of some glacial gravel. The underlying rock formation is sedimentary, consisting for the most part of strata of sandstone or a calciferous grit grading into more calcareous beds on one hand and into gritty shales and slates on the other. All are dark colored, of bluish or greenish cast in the unweathered rock and gray or greenish drab in exposed surfaces. While in places the rock is shaly, it is in others, as seen in outcropping ledges, almost massive or thick bedded.

Mechanical forces have entered largely into the formation of the Dutchess stony loam, though chemical action has had some influence, especially in the more calcareous beds. Where less stony or relatively free from rock outcrop the soil is easy to cultivate, but usually the stones and outcrops interfere more or less with farming operations. A large part of this type is still forested with deciduous trees, the most prominent species being oak, maple, and chestnut. Cedar is quite common, and the locust is often seen. For the most part it is not a strong soil, and much of it appears rather poor, although some parts make excellent pasture land. It is cultivated more extensively in the towns of Rhinebeck and Red Hook than elsewhere, and in the latter town is the principal fruit soil, where there are extensive orchards on it. It produces the Newtown Pippin as well as many other standard varieties of apples. Fruit succeeds best where applications of barnyard manure and fertilizer are made, as the soil needs fertilization, especially with organic manures, to make good yields. The apples attain a good size, and have fine color, flavor, and keeping qualities. This type also supplies largely the soil for the growing of violets in the greenhouses about Rhinebeck, the small rock fragments not being objectionable, although the larger gravel or stones are removed. Except where fruit is grown the soil is not generally desired as farming land, because of the rough surface, and few good farms were seen. It would seem that fruit growing could well be extended here, but, if not, the best use for the cleared land in sections suited for dairying is for pasture and hay. In other places it should be reforested.

The value of the farms in this type of soil varies greatly, so that it is difficult to state just what this land is worth. Some of it is as low as any in the county, while some areas bring good prices.

The following table gives the average results of mechanical analyses of fine-earth samples of the soil and subsoil of the Dutchess stony loam:

Mechanical analyses of Dutchess stony loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18268, 18270.....	Soil	2.0	4.2	2.3	7.7	6.6	66.2	10.8
18269, 18271.....	Subsoil.....	5.0	5.6	2.9	8.5	9.3	60.0	8.8

HUDSON LOAM.

The surface soil of the Hudson loam consists of 8 to 10 inches of light or yellowish brown to dark-brown loam or heavy sandy loam. The soil has a coarse feel, which is imparted by the presence of coarse sand particles and fine gravelly fragments, but the greater part of the surface mass seems to be of finer texture, and in places is practically a silty loam or heavy loam. It is all more or less gravelly, approaching the gravelly loam texture, but the gravel is usually small and less than 10 per cent.

In the upper few inches the subsoil is similar to the soil, but it quickly changes to a gravelly sandy loam containing fine to small gravel, which increases in quantity and size with depth. Generally at less than 36 inches a more gravelly material is encountered, which continues to a considerable depth. On the whole the subsoil appears to be somewhat compact, so that it is more retentive of moisture than might be expected from its texture, and the soil is capable of withstanding ordinary droughts.

Areas of the Hudson loam occur with the other lacustrine soils along the Hudson River and extend back some distance from the river. The largest areas are in the towns of Red Hook and Rhinebeck. It occupies flat areas or terraces marked by few undulations, practically the only relief being draws and ravines eroded by the streams. The elevation of these terraces is about 200 feet above the Hudson River. In origin the Hudson loam is lacustrine, representing a shallow water sediment deposited under conditions of varying currents. It is also possible that some of the finer material from the adjoining upland may have been deposited later as overwash upon these plains.

Its level surface, the absence of stones, except small quantities of gravel, and the consequent ease of cultivation make it a desirable soil, though it is not as durable as some other soils. It is well drained, but fairly retentive of moisture and fertilizers and gives fair yields. It will grow good apples, small fruits, and truck crops, especially heavy truck, such as potatoes, tomatoes, and the root crops. It is an early soil as might be expected, and is made highly productive by

heavy applications of barnyard manure and some commercial fertilizers. There are several commercial apple orchards on the Hudson loam, and the growers as a rule have met with success. The fruit grows to good size, is of fair quality, matures rather early, and is always highly colored, which is important with the red varieties. The Newtown Pippin can be produced on this soil, but it does better on some parts of the heavier soils.

Away from the immediate vicinity of the villages mixed farming is practiced. Dairying is carried on with general farming and fruit growing. Every farm has an orchard, the farmer realizing a considerable income from this source, especially in years when good fruit crops are obtained. Dairying is followed in order to have continuous employment and to keep the land in a productive state by the application of manure.

As a rule the owners of farms in this type of soil are in a prosperous condition. In the northern part of the county farms on this soil are assessed $30 to $50 an acre, but usually where bearing orchards are established the land can not be purchased.

The results of mechanical analyses of typical fine-earth samples of the soil and subsoil of the Hudson loam are given in the table below:

Mechanical analyses of Hudson loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18281	Soil	3.1	12.9	13.8	23.5	9.1	29.9	7.4
18282	Subsoil	6.1	16.7	17.2	28.6	11.2	13.9	6.6

HUDSON CLAY LOAM.

The surface soil of the Hudson clay loam consists of a light or yellowish-brown or brownish-drab heavy, silty clay loam, in which the silt content is very high. On the slopes the soil is shallower and somewhat heavier, and in the more level areas back from the river it is more silty. The depth of the soil ranges from 4 to 5 inches on the slopes to 8 inches or more in the more level situations. Probably the average depth is 6 or 7 inches.

A distinct line separates the soil and subsoil. The color, at first a light yellow or yellowish drab, quickly changes to a mottled drab or bluish drab and yellow. The texture, in the upper part a heavy, plastic silty clay, grades into a stiff, tenacious silty clay. At greater depths dark-blue clays occur. These clays are worked extensively along the river for brickmaking, especially across the Hudson.

The Hudson clay loam is the most extensive of the river or glacial lake terrace soils. Its greatest development is in the northern part of

the county in two areas contiguous to the river. The smaller area begins at a point at Staatsburg, following northward around Vanderburg Cove, and broadening out and extending back along Landsman Kill Creek toward Rhinebeck. The larger area extends as a band along the river, about a mile in width, from Rhinecliff north to Madalin, at which place it extends back from the river about 4 miles along the course of Stony Creek. Some small areas occur at a few places below Staatsburg, where the formation is covered by the sandy and gravelly soils deposited over it along the lower course of the river.

Judging from the remains of some parts of this formation it was evidently a flat terrace, with an average elevation of about 150 feet above the river. Since the formation of the terrace deep draws and ravines have been eroded in it. Nearer the river the result has been to form numerous ridges extending and sloping toward the river. Farther back there are flat areas, as, for instance, along Stony and Landsman Kill creeks. The Hudson clay loam resulted from deposition of sediments in glacial Lake Albany. The fineness of the material shows that it was deposited in deep, quiet waters, which at that time were next to the ice that filled the Hudson Gorge. This deposit was made all along the river, except where rocky areas stood above the water. In places the rocks were just low enough to allow shallow deposits of the clay. In the lower part of the county the clay sediments were finally covered by sandy and gravelly deposits so that the clays do not outcrop, although exposed in pits where brick-making has been carried on.

The Hudson clay loam, because of its heavy character and the imperviousness of the subsoil, is a cold, wet soil. The subsoil is always moist. When the surface dries it shrinks and cracks, and crops suffer from lack of moisture.

The upper part of the area along Stony Creek is generally flat and wet, and drainage is necessary. Other small areas are also wet, but along the river there is generally very good surface drainage. Tile drains would no doubt benefit much of this soil. It is retentive of any fertilizer applied to it, but being a cold, wet, intractable soil, it is not very desirable for general farming. It is, however, a strong soil and especially adapted to grasses, for which it is mainly used. It is said that when wheat was grown this soil produced large yields. It will grow apple trees on the better drained slopes, and even the Newtown Pippin has been successfully produced. The type is benefited by applications of lime, and the tilth is improved by plowing under roughage, such as coarse manures and grass-leguminous crops. Of the tree growth seen on this soil the cedar is most prominent, neglected fields growing up to this species, of which the trees attain good size.

The larger part of this soil type is not under cultivation. It is, however, cleared and has been cultivated at some past time. Along the river fine resident estates are located upon it, and here no attempt is made to farm it. Its value, because of its location, is very high, and none of it is on the market. It is valued highly because of the deposits of brick clay.

The following table gives the results of mechanical analyses of the soil and subsoil of this type:

Mechanical analyses of Hudson clay loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18287.....	Soil	0.0	2.1	1.4	5.2	6.4	63.2	22.5
18288.....	Subsoil.....	.0	1.0	.8	2.6	2.8	59.4	32.5

HUDSON SANDY LOAM.

The surface soil of the Hudson sandy loam consists to an average depth of 8 inches of a yellowish to light-brown medium sandy loam. In texture and structure it varies to some extent. In places it contains high percentages of the fine grades of sand approaching the texture of a fine sandy loam and in others coarser particles are more numerous, in which case it approximates a coarse sandy loam, but these places are small in extent. In structure the soil is generally coherent, holding together when pressed in the hand, but there occur small areas, such as low knolls or piles of sand in which the materials are loose and incoherent and reach to some depth without change of texture and structure. The subsoil is a yellowish medium textured sandy loam, apparently more sandy than the surface, as it lacks the organic matter generally present in the surface soil. It is, however, coherent to some extent, and in the main the texture and structure of the subsoil correspond to that of the surface material overlying it, the only change being the occasional admixture of gravel. It is noticeable that the larger grains are all rounded, showing plainly water action. The subsoil is underlain by clay deposits laid down at an earlier time.

The Hudson sandy loam is not extensive and occurs only in small areas along the immediate banks of the Hudson River. The largest areas are those near Rhinecliff and Staatsburg, but numerous small areas are found all along the river. The soil occurs chiefly as sandy slopes to the river, but at higher elevations it is marked by low knolls or by a rolling topography, with occasional level or nearly level areas. The drainage is good, as would be expected from its position, texture, and structure.

In origin the Hudson sandy loam is lacustrine, representing sediments deposited in glacial Lake Albany. The deposition evidently took place in shallow water and was laid down at a late stage of the lake upon the clay deposit, as the level of the water was lowered. It is an easy soil to work, but very little of it is cultivated. It produces fair yields of all crops grown in the county. It is, however, particularly well adapted to trucking and small fruits.

The following table gives the results of mechanical analyses of typical samples of the soil and subsoil of this type:

Mechanical analyses of Hudson sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18275	Soil	0 1	2.9	13.2	41.2	15.6	18.3	8.4
18276	Subsoil	.1	1.1	6.5	49.4	23.2	12.6	6.8

HUDSON FINE SANDY LOAM.

The surface soil of the Hudson fine sandy loam, to an average depth of 8 inches, consists for the most part of rather heavy silty fine sandy loam, though varying in some places to a light fine sandy loam. In small areas or, rather, little hummocks where the material may have been wind-blown it is more nearly a fine sand, but even here it retains some coherency. The color of the soil ranges from light or yellowish brown to dark brown, the darker color indicating the heavier phases.

The subsoil consists of material similar in texture to the surface soil, but of lighter color, owing to a smaller organic-matter content. The lack of organic matter causes it to appear more sandy than the surface, and probably this is actually the case in the lower depths. It is generally very compact and occasionally the lower stratum carries some gravel, but for the most part the material is practically uniform to the underlying clay deposits. Because of the tendency to compact it makes a good molding sand, and in places it has been mined for that purpose.

The Hudson fine sandy loam is found along the Hudson River in numerous areas, the most extensive being south of Poughkeepsie. It is limited to the terrace section, or valley proper, of the Hudson, where its surface is rolling to hilly, with occasional fairly level areas. Its highest occurrence is on some of the hills, sometimes over 300 feet above the river, but for the most part it lies between the 100 and 200 foot contours. It is well drained, yet retentive of moisture on account of the compactness of the subsoil and the presence of the underlying impervious clays, so that it is not considered a droughty soil. In the spring the areas are wet and can not be worked early in the season.

It is of lacustrine origin, being a sediment laid down in glacial Lake Albany at a later stage than the clay deposits. A part of the material may have been derived through wind action.

The Hudson fine sandy loam, especially the heavier phase, is an easily cultivated productive soil. With the incorporation of organic matter it becomes quite loamy, and particularly well adapted to truck crops, both light and heavy, to small fruit, and even to tree fruits, such as apples and pears.

In the northern part of the county this soil is greatly desired for fruit and vegetables. It will produce the Newtown Pippin, as evidenced by one of the best orchards in the town of Red Hook. The red varieties of apples, such as the King, Baldwin, Northern Spy, and in fact most varieties, do exceedingly well. The fruits mature in good season and color well. It is not quite as early as the better drained gravelly types, so that fruit does not mature quite so early nor color quite so well, yet it is a more productive soil, is in greater demand, and brings a higher price.

Below Poughkeepsie the areas of this soil have practically all been dug over for molding sand, and lying close to the river where it is included in summer-residence estates, it has not been devoted to cultivated crops, but left in grass. It makes fair pasturage, especially where it overlies limestone at no great depth.

The results of mechanical analyses of typical samples of the soil and subsoil are given in the following table:

Mechanical analyses of Hudson fine sandy loam.

Number	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18277	Soil	0.2	1.5	1.2	5.8	38.9	43.4	8.5
18278	Subsoil	.4	1.0	1.1	6.9	48.6	33.1	8.6

MERRIMAC LOAM.

The Merrimac loam consists of 8 to 12 inches of a gravelly dark-brown loam or silty loam of friable, granular character, underlain by gravelly material of lighter color, changing to yellowish and at an average depth of 24 inches or less becoming more gravelly or sandy and resting finally upon a gravelly or sandy substratum. Occasionally a little rounded gravel is found upon the surface and in the soil and subsoil, but the quantity does not exceed 10 per cent of the soil mass, for where more than this occurs it is included in the Merrimac gravelly loam.

The Merrimac loam is not an extensive type, the areas being generally small and associated with the Merrimac gravelly loam. It occurs on the gravelly terraces in the valleys, generally next to the

uplands, and occupies slight depressions. Some of the areas evidently were at one time swampy, but have been drained and made tillable. This type is probably due to wash from the adjoining areas laid down over earlier deposits of gravel, although to some extent it may be old alluvium. This soil is apt to be rather wet and requires drainage. It is an especially strong grass soil, making large hay crops and excellent pasturage. Where not too wet it will make good yields of corn, being especially desirable for producing a silage crop. The soil is inclined to be acid and applications of lime have always proven beneficial.

The results of mechanical analyses of a sample of the soil and subsoil, the latter down to the gravelly substratum but not including it, are given in the following table:

Mechanical analyses of Merrimac loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18296	Soil	3.4	10.4	7.2	10.0	8.0	46.1	14.8
18297	Subsoil	4.0	12.4	6.0	9.7	6.2	46.4	14.9

MERRIMAC GRAVELLY LOAM.

The surface soil of the Merrimac gravelly loam consists of a light-brown loam or heavy sandy loam, containing varying quantities of rounded gravel and a less proportion of flat, shaly gravel. In depth the soil ranges from 6 to 10 inches, with an average of 8 inches. The subsoil is a yellowish gravelly loam or heavy sandy loam, not differing from the soil in texture but carrying less organic matter. It has a more sandy feel and contains more gravel, from fine to coarse, the proportion increasing with depth, until at 18 to 24 inches very little fine interstitial material is found. The quantity of gravel on the surface and in the soil varies from 15 to over 50 per cent. The rock is mostly sandstone and quartz, with some shale or slate, the latter rarely rounded.

The Merrimac gravelly loam is found in all parts of the county, occurring along stream courses in generally narrow, irregular areas. The largest areas are in the Wappinger, Clove, Dover, and Amenia valleys, with a few rather small areas along the Hudson. It occupies the terrace or terraces above the first bottoms, along stream courses, and the areas are as a rule flat or at most only gently undulating, with occasional kettleholes in the larger areas. It is always found above the high-water mark of the streams.

The Merrimac gravelly loam owes its origin to glacial material or drift that has been modified by water. At the close of the Glacial epoch, when the ice was melting, the large volume of water issuing

from the ice front in the valley was loaded with gravel and earthy material, which was soon more or less assorted and deposited as terraces and gravelly plains. This material may have been reworked a number of times, and very often shows cross-bedding. There may also have been later alluvial deposits.

As might be predicted from the manner of its formation and position, the Merrimac gravelly loam is easily drained and at times even droughty. The soil is light and friable, is easily cultivated, and can be handled at any time, as it soon dries off after rains. It is not considered a strong soil, and is not retentive, but makes good yields when fertilizers are applied, and especially with liberal applications of barnyard manure. All the crops grown in the county are produced upon it, and it does particularly well in corn, potatoes, and heavy truck crops. It will also support a good stand of grass and rye, and oats are successfully produced at the present time.

It is considered a fairly good fruit soil, particularly in those areas which are not excessively gravelly and which have better moisture conditions. Apples are said to be of excellent quality as to flavor and color, but the fruit matures rather early and the keeping quality is not so good as those produced on some other soils. Fair yields are obtained, and are best maintained by barnyard manure, the use of cover crops, and green manuring. Pears, as well as apples, succeed upon this soil.

Although this soil is not as strong as some others in the county, it is esteemed for its position, smooth, level surface, and the absence of large stones or bowlders. Some of the good farms of the county are located in whole or in part upon this soil type, and seem to have been in demand in the past for stock farms, and particularly for horse raising, as the conditions of drainage make them well suited to tracks for training purposes.

The average results of mechanical analyses of fine-earth samples of the soil and subsoil are given in the following table:

Mechanical analyses of Merrimac gravelly loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
16993, 16999, 18293.	Soil	10.1	13.7	6.7	8.1	9.4	39.8	11.9
16994, 17000, 18294.	Subsoil	10.8	15.3	6.8	8.3	11.0	36.5	11.3

MERRIMAC GRAVELLY SANDY LOAM.

The soil of the Merrimac gravelly sandy loam consists of about 8 inches of a light gravelly loam or sandy loam. The surface material is light brown, changing to yellowish a few inches below. The soil has a distinctly sandy feel, owing to the presence of a relatively high

percentage of coarse sand, but contains over 30 per cent of silt and nearly 8 per cent of clay. The surface is covered with rounded gravel, generally not exceeding 2 or 3 inches in diameter and for the most part much smaller, and the soil not infrequently contains 40 per cent of such material. The quantity increases with depth and at about 12 inches the subsoil is largely composed of gravel of all sizes, with only a small quantity of sandy interstitial material.

The Merrimac gravelly sandy loam is found in most of the towns of the county, although not in very large areas. They are associated with the Merrimac gravelly loam, though they lie farther back from streams and next the upland, or on the sides of the valleys.

The surface of the Merrimac gravelly sandy loam is entirely distinct from that of any other type. It is marked by rounded knolls or hills with smooth slopes rising from 20 to 60 feet or more in height, with frequent kettle-hole depressions between them. The hills may occur singly or in a series, but they have no regular arrangement. The slopes are as a usual thing quite steep and difficult to cultivate, but they are smooth and no large stones or bowlders occur on the surface nor are there any rock outcroppings. The mass is glacial debris, but unlike the material giving rise to the gravelly loam it has not been assorted by water, or, if at all, only in a few places. It may be morainal in origin.

The Merrimac gravelly sandy loam is a light, porous soil, not retentive of moisture, and on account of its liability to drought is not a desirable agricultural soil. It is cultivated to a slight extent but yields are small. It is poor grass land, though it will support a grass cover and generally forms a part of the permanent pastures. Little of it is forested.

The average results of mechanical analyses of samples of the surface soil of the Merrimac gravelly sandy loam are given in the following table:

Mechanical analyses of Merrimac gravelly sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
16992, 18295.....	Soil	15.6	18.6	6.5	12.0	8.5	30.8	7.9

DOVER FINE SANDY LOAM.

The surface soil of the Dover fine sandy loam consists on the average of 8 inches of light-brown heavy or silty fine sandy loam or in places a light loam, generally containing considerable finely divided mica flakes. The soil for the most part is of a fluffy character, especially on the tops of the ridges where the underlying dolomite is

close to the surface. When wet it has a slick or greasy feel, imparted to it by the mica flakes. It contains fine gravelly fragments, and some glacial gravel bowlders also occur, though nearly all the larger stones have been removed to build the field walls. Many outcrops of the underlying rock are found on the tops of the hills and ridges, and on the upper or steeper slopes.

The subsoil is a yellow, sometimes reddish-yellow, silty, fine sandy loam becoming generally more sandy with depth. Where the underlying rock lies within 36 inches of the surface or thereabouts, as it generally does on the ridges, the subsoil runs into a gray fine sand, which is nothing more than the disintegrated rock or dolomite. Where the rock comes near the surface the light fluffy organic mold merely covers this disintegrated rock material, but on the lower slopes, where the wash from above has collected, the depth is much greater than the soil profile—36 inches—and the material is more silty and darker colored. The subsoil, like the soil, contains considerable quantities of finely divided mica, which, when the quantity is very large, gives it a distinctive slick or greasy feel.

The Dover fine sandy loam is found in broken areas in the eastern tier of towns, and is not an extensive soil type. It is a valley soil and occurs on both sides of the valley in the eastern part of the towns indicated along Swamp River, Tenmile River, and Webatuck Creek. Its topographic features consist of hills and ridges rising rarely more than 100 feet above the valley floor. Near the streams the ridges and hills are low and sometimes merely disconnected knolls and knobs, while next the upland they become much higher. All are marked by an uneven surface, due to outcropping ledges of rock, and these are generally so numerous that cultivation is difficult. The slopes of the hills and ridges, particularly the upper parts, are very steep and in places almost precipitous and unfit for cultivation.

The uneven surface and nearness of the areas to the drainage channels afford ready surface drainage, and the texture and structure of the soil and subsoil permit the downward percolating of water. The soil is, in fact, inclined to be droughty, and grass, in dry spells, apparently burns out, but, as on the Dover loam, or "limestone land," it recuperates quickly after rains.

The Dover fine sandy loam is of glacio-residual origin and is derived from a dolomitic rock—the Stockbridge dolomite—of Cambro-Silurian age, metamorphosed more or less to marble. In the northern part of the county it seems to be less metamorphosed and approaches limestone, and in the town of Northeast the Dover fine sandy loam is displaced by the Dover loam. Interbedded with the dolomite are thin beds of dark-colored slate, which slightly influence the soil in their proximity.

This rock weathers rapidly—much more so than the contiguous rock formations—and to this, no doubt, is due the steep valley of which it forms the floor. It is a common occurrence to see the white sand upon the surface where a rock outcrop is disintegrating, and wherever the rock surface is met in the soil profile it is overlain by several inches of this disintegrating material or sand. At greater depths, where the formation is not affected by weathering, good building marble is quarried, and a large quarry is in operation in the town of Dover.

The Dover fine sandy loam is a light, friable soil and therefore in itself easy to cultivate, but the rough surface and rock outcrops limit cultivation to small areas less broken. It is, however, a productive soil and repays the effort of cultivation. Its best use seems to be for pasturage, the sod being strong and lasting, though dying down during dry hot spells. The soil is practically all cleared and is devoted largely to grass. Cedar is the characteristic tree growth of this soil. Aside from its agricultural value, it is held at high prices because of the probable occurrence of valuable marble veins.

The following table gives the results of mechanical analyses of fine-earth samples of the Dover fine sandy loam:

Mechanical analyses of Dover fine sandy loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent*	*Per cent.*	*Per cent.*	*Per cent*	*Per cent.*	*Per cent.*
17001	Soil	2.4	5.3	8.4	13.0	22 1	48.5	5 1
17002	Subsoil	2.6	4 2	8.3	12 6	23 5	41 0	12 2

DOVER LOAM.

The surface soil of the Dover loam varies in depth from 6 to 10 inches, with an average of 8 inches. It consists of a light loam or silty loam, and in small areas of a rather heavy loam, varying in some places to a heavy silty fine sandy loam. The color is light or yellowish brown to dark brown, with a reddish or reddish-yellow cast in the heavier areas, and close to the rock being sometimes a rusty red. The soil has a soft feel, is friable, and has a granular structure. It also carries noticeable quantities of glacial gravel, as well as blocks of stone, largely limestone, of which there are numerous outcrops.

The subsoil is similar in texture to the soil, but becomes heavier immediately above the limestone rock, and here it is sometimes so silty and clayey as to be a plastic silty clay loam. The subsoil, although granular when wet, is more or less sticky. It contains considerable particles of fine to small gravel. Some limestone blocks,

and in places glacial gravel, are scattered through it, but as a rule the gravel is confined to the surface soil. The subsoil in some places exceeds a depth of 36 inches, but rock outcrops are plentiful, and the underlying limestone is often near the surface. The color of the subsoil is yellowish, changing with depth to a more or less reddish yellow and sometimes to red in the heavier places. It is this distinctive coloring of the subsoil that aids in distinguishing this from the other soil types in the county.

The Dover loam is found in all the towns in the county, except Pawling and Dover, though in some of the towns, such as Red Hook, Rhinebeck, and Hyde Park, the area it covers is small. The largest extent is in the towns of Fishkill and East Fishkill and following up the Clove Valley. Other areas occur more or less continuously in the valleys of Wappinger Creek and Fallkill Creek. The areas are not, as a rule, large and are interrupted by areas of glacial debris.

The Dover loam occurs in the lower parts of the county—the stream valleys—where it consists of hills and ridges. The former are smoothed to some extent, but on the whole, owing to outcropping ledges of limestone, the surface is uneven, in some places so much so that cultivation, except in small patches or fields here and there, is difficult. The extremely rough areas, however, have been included under Rough stony land. In general, the hills and ridges rise 40 to 100 feet above the general level of the valleys, and particularly in the southern part of the county some attain elevations of 200 or 300 feet, or over 700 to 800 feet above sea level. The areas of this type of soil are well drained.

The Dover loam appears to be largely of residual origin. The character of the soil and subsoil, particularly the latter, is similar to the soil material derived from limestone in other surveys. The limestone has, however, been glaciated in some situations and the surface soil, especially, is not very different from the true glacial types. Here glacial gravel is found. The loose bowlders that now form the field walls were evidently broken off by the ice and strewn over the surface, but that they have not been subjected to much grinding is shown by their angularity. The limestone varies from light gray or blue to dark blue, and while the greater part of it is massive, a considerable part is brecciated. It occurs in strata interbedded with the shales and slates of the Hudson River group of rocks and is of Cambro-Silurian age. The rock is hard and comparatively resistant to weathering, as evidenced by the outcrops. In general this class of rocks is highly soluble and the soil is the insoluble residue left from the solution of large masses. The process of formation of this soil has thus been largely chemical.

The Dover loam is known locally in the county as " limestone land " and is a highly productive soil for all the crops grown in this county

and especially prized for pasture. The soil is friable and easily worked, except where the rock outcrops or lies too close to the surface. It will produce more corn than any upland soil in the county, does especially well when planted to the small grains, and will give large crops of hay. It is rather droughty and in dry spells crops suffer for want of moisture, but whenever rain falls they recuperate quickly and in an incredibly short time grass, for instance, although apparently burnt out, starts growing and takes on a good color. Over the greater part of this type, where a mowing machine can not be used because of the unevenness of the surface and the presence of rock outcrops, its best use is for pasturage for stock. In addition to the general farm crops this soil seems also fairly well adapted to fruits, and large crops of apples are produced.

The Dover loam maintains its productiveness better than any soil in the county and is the most responsive to good treatment. Applications of barnyard manure, commercial fertilizers, or of almost any fertilizing material, together with good cultivation, are always rewarded by greatly increased yields. Lime has always been found beneficial and is obtained cheaply from the local limestone beds, though the practice of applying lime is not general.

Land of this type is almost all cleared, and only some of the rougher spots remain in forest. Cedars are of common occurrence and seem particularly partial to this soil, some areas being entirely covered by them. Locust is commonly found, especially along the walls surrounding the fields. Some of the best farms in the county are wholly or in part "limestone land," and the owners as a rule are prosperous and have good dwellings, barns, and outbuildings. The farms are usually well stocked. Though the greater part of this soil is away from the larger towns, it has a high assessed value.

In the following table are given the average results of mechanical analyses of fine-earth samples of the soil and subsoil of the Dover loam:

Mechanical analyses of Dover loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
17285, 18259.....	Soil	2.7	6.6	4.2	11.8	9.5	52.3	12.8
17286, 18260.....	Subsoil.....	1.8	6.7	4.3	12.5	8.1	52.4	13.8

PODUNK FINE SANDY LOAM.

The surface soil of the Podunk fine sandy loam consists, on the average, of 8 inches of light to dark-brown fine sandy loam, rather silty, and containing a high percentage of very finely divided mica, the latter imparting a more or less greasy feel. The subsoil is a

yellowish fine sandy loam changing to fine sand, which may rest on a gravelly stratum at less than 36 inches below the surface. Like the soil, it is very micaceous, the particles being finely divided.

This is the least extensive soil in Dutchess County, there being only two small areas, amounting to less than 1 square mile. They are found on one of the small tributary streams of the Swamp River in the southeast corner of the county, in the town of Pawling, and occur as bottom-land areas and are of alluvial origin, being deposits of the fine sandy wash from the slopes, left by the stream in its flood plain. Both texture and structure favor drainage, but its low-lying position subjects it to frequent overflow. It is an easily cultivated and productive soil and gives good yields of grass and of the cultivated crops, especially corn. The same soil is found in extensive areas along the Connecticut and Merrimac rivers in New England, where it has been previously mapped.

RHINEBECK LOAM.

The surface soil of the Rhinebeck loam, which has an average depth of 8 inches, varies from a light silt loam or silty loam to a light loam or heavy fine sandy loam. The subsoil, too, is variable, but consists for the most part of light silty loam to silt loam. It is in general of yellowish color, but often mottled yellow and drab, especially in lower depths. It exceeds 36 inches in depth—the limit of the soil profile.

Soil of this type occurs along Landsman Kill, in the town of Rhinebeck, extending into the town of Red Hook, and covers only a small area. The areas lie less than 20 feet above the stream courses, and have a rolling to nearly flat topography, the relief being sufficient to afford fair surface drainage.

In origin the Rhinebeck loam is uncertain, though it seems to have resulted from the intermingling of the materials that go to make up the Hudson clay loam and Hudson fine sandy loam, modified by later alluvial material. It is an easy soil to till and is fairly productive of all the crops that are grown in this section. Corn does well, and some cabbage seen growing on it indicated that it is a good soil for that crop. The lower lying parts are best adapted to grasses for hay and pasturage. It is all cleared and is or has been under cultivation.

The results of mechanical analyses of samples of the soil and subsoil of the Rhinebeck loam are given in the following table:

Mechanical analyses of Rhinebeck loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18298	Soil	1.2	2.7	2.0	9.6	6.2	68.1	19.7
18299	Subsoil	.3	.9	.8	3.6	4.4	72.9	16.4

HUNTINGTON SILT LOAM.

The surface soil of the Huntington silt loam consists for the most part of a rather heavy silt loam of a light or drab color, but varies to a yellowish-brown light silt loam or silty loam. It averages about 8 inches in depth. The subsoil is more variable, but generally is a yellowish, yellowish-drab, or purplish-yellow silt loam. In some of the lower situations it is heavier, being a silty clay loam or even a silty clay. It is more or less plastic, the heavier phases being often mottled yellow and drab. This sort of subsoil is spoken of as clay foundation by the farmers. In the lower depths, generally at less than 36 inches from the surface, it becomes sandy and sometimes is underlain by a compact, fine to medium, drab-colored sand or by a gravelly stratum.

The Huntington silt loam occurs in all parts of the county, as small, rather narrow first-bottom areas along streams, and is usually subject to overflow. Some of the areas, however, occur at the heads of streams or as depressions in drained meadows. It represents flood deposits of the materials washed from the immediate slopes and mixed with that brought down from farther upstream. It is therefore somewhat variable. Lying so low and close to the streams it is more or less saturated during wet spells, but the higher parts have good drainage and are well adapted to corn. Practically all the areas mapped are capable of growing cultivated crops. Its best use, however, is for grasses for hay, and for pasturage it is not excelled by any soil in the county, as the moisture conditions are favorable to a continuous and heavy growth of the pasture grasses.

At present the greater proportion of this soil is either devoted to hay or pasturage, and its occurrence in a farm greatly enhances the value. It is highly prized, but owing to limited development it really has little influence on farm value in general.

The results of mechanical analyses of samples of the Huntington silt loam are given in the following table:

Mechanical analyses of Huntington silt loam.

Number.	Description.	Fine gravel.	Coarse sand.	Medium sand.	Fine sand.	Very fine sand.	Silt.	Clay.
		Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
18289	Soil	0.2	1.0	0.6	6 2	15.0	65.1	11.0
18290	Subsoil	.0	1.0	.8	2.6	5.1	72.7	16.9

ROUGH STONY LAND.

Rough stony land includes all those areas too steep and stony for cultivation, but which are of some value for forestry or, if cleared, for pasturage. Occasional small patches of soil occur that may be

cultivated, and these would be shown as some other type of soil if it were not for the fact that they are too small to be shown on a map of the scale of 1 inch to the mile.

In Dutchess County the areas of Rough stony land are found on the tops and slopes of the mountains, on the slopes of hills and ridges, and occasionally on rocky knolls in the valley floors. The areas occur in all parts of the county, and the total extent is quite large. The most prominent development is in the southern part of the county, where areas occur covering the Fishkill Mountains, continuing on Chestnut Ridge and the mountains along the eastern boundary. In some places the topography is quite rugged. The areas scattered over the remainder of the county are generally small and occupy steep slopes where rock outcrops are numerous. The type includes all the rock formations, but the greatest development is in the pre-Cambrian formation of gneiss and granite. In this formation huge bowlders are commonly strewn over the surface, and rock outcrops are plentiful. The bowlders are subangular to rounded, showing the work of ice action. In the dolomite, limestone, and slate series of rocks the outcropping ledges are the prominent feature, not of sufficient extent to class as Rock outcrop, but of sufficient steepness of slope or uneven surface to preclude cultivation. There is, however, enough soil between the outcrops to support a growth of grasses or forest. Here the work of glaciation was feeble, resulting merely in removing the preglacial soil mantle, if there was one, and in depositing only a small quantity of glacial debris here and there, so that the interstitial soil is doubtless largely residual and derived from the immediate rocks. The agricultural value varies. Areas in which dolomite and, particularly, limestone are found are highly prized because of their value as pasture lands. For the most part, however, the areas of Rough stony land are in forest, consisting chiefly of oak and chestnut. On the mountains occur some black pine and other scrubby growth and in the ravines hemlock, while on the dolomite and limestone formations cedar is the predominant growth, and on cleared areas locust is common.

The general value of Rough stony land is very low, but where small areas are included in a farm the value of the whole is not greatly affected, such areas being considered as woodland or rough pasture. These uses are the best to which Rough stony land can be put, and forestry in particular would be remunerative. In a few favorable locations where the soil is sufficient orcharding might be made profitable.

MEADOW.

In Meadow is included low areas lying in depressions or along stream courses and too wet to cultivate unless drained. Such areas

usually support a growth of water-loving grasses, shrubs, and trees, or in the wetter parts rushes.

The soil material varies widely, but consists mostly of drab-colored light to heavy silt loam. The subsoil is variable, but, like the soil, is most often a heavy silt loam, though ranging from a typical silt loam to a sandy silt loam. All these several phases of the subsoil are grouped under the local term "clay foundation." The subsoil is more or less impervious, and the surface is wet practically throughout the year. The lower lying parts of areas are often more or less mucky, especially along Swamp River, in the Dover and Pawling Valley, in the eastern part of the county. Some areas are peaty. Some of the land included in Meadow is really Swamp, and some smaller areas of Muck occur, but these were too limited to warrant separation. Of the tree growth, elm and soft maple are the most prominent, and along the upper course of Webatuck and Nortse creeks, in the northeastern corner of the county, some tamarack is found.

The Meadow is distributed generally over the county in long, narrow areas, the largest occurring along Swamp River and Webatuck, Nortse, and Wappinger creeks. These areas are due without exception to obstructed drainage caused by glaciation.

Agriculturally these areas at present have very little value, as they are usually too wet to be cultivated. Some swamp grasses are cut, and the drier portions make excellent pasturage and in some cases good hay crops in dry seasons, but this is the extent of its present use. The mucky areas should be utilized for such crops as celery and onions. There are valuable areas that could be reclaimed by drainage, but in the majority of cases drainage is not feasible or at least is so difficult that the expense would be quite high.

MADELAND.

The term "Madeland" has been applied to small areas along the Hudson River, where extensive docks have been built, and to the large clay banks, quarries, and iron mines, where a sufficient area has been dug over to warrant mapping. Madeland has no agricultural value.

ROCK OUTCROP.

The Rock outcrop represents areas where outcropping ledges occupy so much of the surface that the land is of no agricultural value whatever. In places such areas are steep precipices; in others they are rough tops and slopes of mountains. The tree and shrub growth is sparse and stunted, hemlock being most prominent in the ravines, and black pine, scrubby oaks, and chestnut, with huckleberry bushes, in other parts. There are only a few areas of Rock outcrop. The largest of these is on Breakneck Ridge, and other areas are found on the tops and higher parts of the Fishkill Mountains in the southwestern part of the county and on the mountains in the extreme northeast corner.

SUMMARY.

Dutchess County is situated in eastern New York along the east bank of the Hudson River. It comprises an area of 511,872 acres, or approximately 800 square miles. Its surface is uneven, the topography being hilly to mountainous. The surface configuration has been modified more or less by glaciation. The elevations range from sea level on the Hudson to over 2,300 feet on the highest mountain. The county is drained by a number of creeks, which empty into the Hudson. The eastern part of the county drains into the Housatonic River, in Connecticut.

Poughkeepsie, the county seat, situated in the central part of the county, on the Hudson River, is the largest city, with about 25,000 inhabitants. It has important manufactories and is a railroad center and shipping point for the river traffic. Fishkill-on-the-Hudson and Matteawan are the next in importance, having together a population of 10,000.

The county has exceptionally good transportation facilities. There are a number of different railroads and on the Hudson River several steamboat lines.

Farm products meet with ready sale in the residential and manufacturing towns of the county. The important outside market is New York City, where the greater part of all the products shipped is disposed of.

The settlement of Dutchess County began about 1685. The settlers were mainly Dutch, with some of English descent from New England and a few French Huguenots. The settlement and development for the first half century was slow, but after that it was rapid, and by the time of the Revolution the county was important in population, manufacturing, and agriculture.

The chief specialty in the county is dairying, which became of importance in the middle of the last century, coincident with the development of railroad transportation, and the important crops are mainly those necessary to the dairy industry. Before that cereal production had been the leading branch in the western part of the county and stock raising in the eastern. Apple production now is also an important industry, supplementing dairying on many farms.

Crop rotation is practiced but not followed closely. It consists of corn one year, followed by small grain one or two years, and then grass, cutting it for hay for two or three seasons, and following that with pasture for indefinite periods.

Excluding the nonagricultural lands, seventeen types of soil were encountered in the county. These follow rather closely the character of the rock with which they are associated, although more or less affected by glaciation. The soils associated with the metamorphic

crystalline rocks are included in the Gloucester series. Those from the limestone and dolomites are in the Dover series, from the former a loam and from the latter a fine sandy loam. These are very productive soils and highly prized.

The soils associated with the Hudson River group of shales, slates, and grits form the Dutchess series and consist of a silt loam, a stony loam, and a slate loam. The silt loam is most largely of glaciated material. All the foregoing upland soils may be classed as glacio-residual in origin.

In the stream valleys occur gravelly types from glacial debris removed by water and deposited. They are included in the Merrimac series, a group of soils occurring in the valleys throughout New England. Along the Hudson is a series of soils of glacial lake or lacustrine origin laid down as sediments in Lake Albany, a body of water existing at the close of the Glacial period. They have been included in the Hudson series and consist of a clay loam, loam, fine sandy loam, and sandy loam. Two soil types of recent alluvial origin are found along streams. They are not extensive, but are highly productive soils.

The adaptation of the soils to crops is generally recognized. All the upland soils are suited more or less to grasses, the stony soils not being quite so strong, though earlier. The limestone lands are most highly prized for grasses, for hay, and pasturage. Alfalfa would doubtless succeed on these calcareous soils. Corn also does best on the limestone soils of the uplands. Where the location and exposure are favorable all the upland soils are adapted to apple culture. Of these soils, the Dutchess silt loam and Dutchess stony loam are the most extensively used for this purpose, large orchards occurring on them. The "slaty lands" are also used to some extent. Apples are also grown on the gravelly and sandy terrace soils, where the fruit yields well, colors highly, and has a good flavor, but matures earlier and has, therefore, not the good keeping qualities of apples grown on the later upland types. The sandy and more loamy soils of the valleys and along the Hudson would be well adapted to truck crops, but they are not used to any appreciable extent for this purpose.

The Dutchess stony loam seems to have a peculiar adaptation to violet culture, though some of the other soils are used successfully for this purpose.

The farmers have generally good houses and barns, and the homes have many modern conveniences. The county roads are excellent, enabling the farmer to reach railroads and other points easily. Telephones and daily rural mail service are available. With the keeping of summer boarders, which has become an important business, the income of many has been augmented.

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U.S. DEPT OF AGRICULTURE
BUREAU OF SOILS
MILTON WHITNEY, CHIEF

SOIL MAP
NEW YORK
DUTCHESS COUNTY SHEET

NEW YORK STATE COLLEGE OF AGRICULTURE
CORNELL UNIVERSITY
L. H. BAILEY, DIRECTOR
R. O. FIPPIN IN CHARGE OF SOIL SURVEY

SOIL PROFILE
(3 feet deep)

Dutchess stony loam
Sil
Sil

Dutchess slate loam
L
L

Dutchess silt loam
Sil
Sil

Gloucester stony loam
L
L

Gloucester loam
L
L

Merrimac gravelly sandy loam
Sl
S & gr

Merrimac gravelly loam
L
L

Merrimac loam
L
L
S & gr

Hudson sandy loam
Sl
Sl

Hudson fine sandy loam
Fsl
Fsl

Hudson loam
L
L
Sl

Hudson clay loam
Sil
Sicl

Dover fine sandy loam
Fsl
Fsl

Dover loam
L
L

Podunk fine sandy loam
Fsl
Fsl

Huntington silt loam
Sil
Sil

Rhinebeck loam
L
L

LEGEND

Sil Silt loam
L Loam
Fsl Fine sandy loam
Sl Sandy loam
S & gr Sand and gravel
Sicl Silty clay loam

LEGEND

Dsl Dutchess stony loam
Dl Dutchess slate loam
Ds Dutchess silt loam
G Gloucester stony loam
Gl Gloucester loam
Ms Merrimac gravelly sandy loam
Mg Merrimac gravelly loam
Ml Merrimac loam
Hs Hudson sandy loam
Hf Hudson fine sandy loam
Hl Hudson loam
Hc Hudson clay loam
Df Dover fine sandy loam
D Dover loam
P Podunk fine sandy loam
H Huntington silt loam
Rl Rhinebeck loam
Rs Rough stony land
M Meadow
R Rock outcrop
Marsh
Madeland

Soils surveyed by
Charles N. Mooney and H. L. Belden
1907.

Scale 62566
1 0 1 2 3 4 Miles
1 0 1 2 3 4 5 Kilometers
Contour-interval 20 feet.
Datum is mean sea level.

A. HOEN & CO. BALTIMORE MD.

BASE MAP FROM
U.S. GEOLOGICAL SURVEY
SHEET 8

Field Operations
Bureau of Soils
1907